A COMPARISON OF THREE READING MEDIA FOR THE BLIND: BRAILLE, NORMAL RECORDING, AND COMPRESSED SPEECH.

by

Dean W. Tuttle

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A Comparison of Three Reading Media for the Blind: Braille, Normal Recording, and Compressed Speech

Abstract

Dean W. Tuttle

Purpose: This study attempted to compare reading by braille (B), reading by listening to normal recording (N), and reading by listening to compressed speech (C) with respect to an index of learning efficiency (comprehension score per unit of time).

Sample: Braille readers, 14 through 21 years of age who were attending schools in California were included in the sample. Students with additional handicaps were not excluded.

Research Design and Metho~~l~~dology: After an introduction to reading by listening to compressed speech, each subject took three equivalent forms of the Reading Versatility Test, Intermediate Level; one in braille, another in normal recording and a third in compressed speech. Care was taken to distribute the effects of form and order. Each test included four prose reading selections and 24 multiple-choice questions. Students were permitted to skip or reread any of the reading selections whether B, N, or C. An index of learning efficiency was computed for each test by dividing the number of

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minutes spent reading the selections.

One hundred and four subjects satisfactorily completed the testing procedures. Utilizing the medians of both braille comprehension scores and normal recording comprehension scores, four levels were identified: high braille readers, high listeners (39 subjects); high braille readers, low listeners (13 subjects); low braille readers, high listeners (13 subjects); and low braille readers, low listeners (39 subjects).

An analysis of variance procedure was used to analyze each of the contrasts B - N, N - C, and B - C, across the four levels and overall.

Conclusions: 1. For the total sample, there was no difference in comprehension among the three reading media.

2. For the total sample, reading by braille took almost twice as long as reading by listening to normal recording and almost three times as long as reading by listening to compressed speech.

3. For each of the four levels, reading by listening to compressed speech was more efficient than either reading by braille or reading by listening to normal recording.

4. For the total sample, reading by listening to normal recording which, in turn, was more efficient

than reading by braille.

Implications: This study focused on but two aspects of reading behavior: comprehension and time. The reading of graphs, maps, and other technical materials was not represented in the tests. The effects of reading by listening on the acquisition of allied skills such as spelling and punctuation were not examined.

However, this study has demonstrated that blind students do not all respond in the same way to reading by braille and reading by listening. There are some students who comprehend much more through one medium than the other. This implies that, for any given individual, textbooks and recreational materials must be made available in the medium which is most effective for him.

Since compressed speech is the most efficient of the three reading media under study, local, state, and national agencies must not hesitate to provide visually handicapped students with materials in compressed speech in order to help them meet ever increasing reading demands. Furthermore, since reading by listening is an effective reading medium for the blind, it may very well be an effective reading medium for the sighted who encounter difficulty reading print.

This study does not imply that braille is outmoded. Braille is still the most exact medium for reading and writing for the blind.

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Braille, Normal Recording, and Compressed Speech

By

Dean William Tuttle

B.S. (Wheaton College, Illinois) 1958
M.A. (Teachers College, Columbia University) 1960
M.A. (San Francisco State College) 1962

DISSERTATION

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Georgie Lee Abel

Committee in Charge

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A COMPARISON OF THREE READING MEDIA FOR THE BLIND: BRAILLE, NORMAL RECORDING AND COMPRESSED SPEECH

Chapter I

Statement of the Problem

Reading is crucial to demonstrating one's competency in this nation's achievement oriented schools. They place a high premium on literacy and consequently, devalue those who cannot read or write. During the school years and after, many demands are placed on an individual to read a wide variety of materials. Many school hours in the elementary grades are spent learning to read. For those who are unsuccessful, the intensive training continues at the secondary level. When a child experiences difficulty in learning to read, he is frequently sidetracked and held back from many other learning experiences on the assumption that reading is a necessary prerequisite for the acquisition and assimilation of knowledge.

For the purposes of this study, reading is defined as the recognition, interpretation, and assimilation of the ideas represented by symbolic material. Words are viewed as symbolic whether displayed in a visual, tactual, or auditory mode. For the students who can

adequately master the motor, perceptual, integrative and comprehension skills involved in reading, it becomes a valuable tool for information retrieval. However, for those students who experience a breakdown in any or all of the skills mentioned above, the resultant "reading disability, more than any other single handicap leads on to school failure and frustration" (Bower, 1966, p. 40).

Dr. Roy Butz, who is the Director of the Reading and Language Center, Oakland County Service Center, points out that

> the educational experience provided by the standard public school program is built on the supposition that those who receive the experience know how to read. Success in the program depends upon the ability to read and, to the extent that the child has a reading problem, he has a reduced opportunity to learn what he would need to know in order to succeed in the program. Unfortunately, when a child reads poorly, this lack of ability is often interpreted as but one manifestation of a general lack of learning aptitude (Foulke & Robinson, 1970, p. 16).

This implies that students may be erroneously classified as having a general lack of learning aptitude on the basis of a reading deficiency. There may be some students who are able to learn to process information even though they cannot read. For the sighted, schools have been unable to consider other

modes of reading for information retrieval. Yet for the visually handicapped, alternatives to reading print have gained acceptance out of necessity. This study will focus on three of these alternatives: reading by braille, reading by listening to normal recording, and reading by listening to compressed speech.

For the blind, braille is the generally accepted alternative to print and is the best tactual system for reading and writing thus far devised. Braille is invaluable and indispensable, for it has enabled a far greater degree of independence with respect to daily living skills than would have been possible otherwise. Braille provides a medium for data recording and retrieving for such things as addresses, telephone numbers, recipes, messages, etc. At best, however, it is bulky, awkward and slow. The average braille reader is from two to three times slower than the average silent, visual reader. Obviously, the mind can process input data at a faster rate than braille permits (Fergen, 1954).

Another alternative available to the visually handicapped is reading by listening to recorded materials, frequently referred to as "Talking Books." This permits processing data at the rate at which material can be read aloud, a rate faster than that

of the average braille reader. However, this reader then loses the advantages of a spatial display such as indentations, skipped lines, charts, etc. He also loses the ability to skip, skim, or quickly retrace the material. The person who reads by listening is limited to the temporal display of the material at any given instant. Though a special format for oral reading has been established (Helms, 1962) to offset some of these disadvantages, the rate of reading by listening still does not approximate that of the silent visual reader. With either braille or currently available recorded materials, the blind person does not have sufficient time to meet all the reading demands placed upon him.

A third alternative becoming available to the visually handicapped is reading by listening to compressed speech. There are several methods for increasing the word rate of a recording. The oral reader recording the material could simply speak more rapidly. However, one cannot speak more rapidly for very long before articulation errors begin to occur and inflection is lost. One can also increase the playback speed of the record or tape above that at which it was recorded. Though this is satisfactory within certain limits, the resulting voice distortion produces the "Donald Duck" effect. A more

satisfactory method of speech compression was developed by Dr. Grant Fairbanks (1954) at the University of Illinois, using an electro-mechanical device for the purpose of randomly sampling a recording.

In Chapter II, Background and Review of the Literature, it will be noted that people of average or above-average intelligence can comprehend compressed materials up to 275 words per minute with minimal loss in comprehension when compared with listening to uncompressed materials. Several other studies suggest that those classified as educable mentally retarded (EMR) can comprehend recorded materials compressed up to 250 words per minute with minimal loss in comprehension. This more nearly approximates the rate of the silent visual reader.

The prevailing assumption mentioned above, that reading is a necessary prerequisite for the acquisition and assimilation of knowledge, has its counterpart in the education of the blind. Braille is taught as the primary mode of reading. If a blind child has difficulty learning braille, he is frequently side-tracked and held back from many other learning experiences, much as a sighted child who has difficulty learning to read print. He is then given many additional hours of intensive training in braille on the conscious or unconscious assumption that learning

to read braille is a necessary prerequisite for the acquisition and assimilation of knowledge.

A review of the studies done among sighted children demonstrates that there is only a moderate correlation (.35 to .52) between reading and listening (Blewett, 1949; Fergen, 1954). This would suggest that there are some students who would learn better by reading than by listening. It would also suggest that there are other students who would learn better by listening than by reading. Still others would learn equally well by either mode (Fergen, 1954; Goldstein, 1940; Lowenfeld, 1945).

> There are reasons for believing that many of those who read poorly can listen effectively. If these children had been allowed to read by listening they might have prospered in the educational program. The poor performance of these children may simply be a consequence of the inflexibility of an educational establishment which insists that they continue to try to use a channel of communication which, for them, is ineffective and refuses to help them make use of a channel that would work (Foulke & Robinson, 1970, p. 16). (Compare Davy, 1971.)

Reading--whether print, braille, normal recording or compressed speech--is utilized for many different purposes. Four of these can be described as: (1) Reading for general information, (2) reading for detailed or technical information, (3) skimming for main ideas, and (4) scanning for a specific idea. An

efficient reader will adjust his style and rate in keeping with his reading objective.

The relative effectiveness of reading as opposed to listening is somewhat dependent on the age of the child. It has been shown that students of the elementary grades do listen better than they read because their reading skills have not been sufficiently developed. By the time students have reached the seventh grade, those who have developed good reading skills find this mode more effective than listening (Russell, 1928; Cody, 1962).

This study assumes that comprehension through reading by braille and comprehension through reading by listening to normal recording will not be the same for all students. Some students will score high in both while others will score low in both. It is expected that a few students will comprehend much more through one medium than the other. This study will attempt to identify students with each of these characteristics.

This study seeks to answer the following questions:

1. For blind students, age 14 to 21, which of the three reading media, braille, normal recording or compressed speech, is most efficient as measured by an index of learning efficiency (correct responses per unit of time)?

2. Within each of the four levels of subjects (high braille readers, high listeners; high braille readers, low listeners; low braille readers, high listeners; low braille readers, low listeners) which of the three reading media, braille, normal recording or compressed speech, is most efficient with respect to an index of learning efficiency (correct responses per unit of time)?

Chapter II

Background and Review of Literature

Support for Underlying Assumption of This Study

The underlying assumption is that reading by listening is a valid form of reading. Dr. Emerson Foulke (1969-1970) wrote a series of articles entitled, "Reading by Listening." He briefly compared the processes and skills involved in three forms of reading: print, braille, and listening. Reading, including reading by listening, is viewed as an active processing of symbols, be they visual, tactual or auditory, for the intelligibility and comprehension of message units. Several studies have compared reading by braille with reading by listening (Lowenfeld, 1945; Nolan, 1966; Steel, 1969). Having identified 11 different skills, Hackett (1968) studied the hierarchy of skills in listening comprehension and reading comprehension, and found them to be similar.

Need for Compression

Part of the problem of word rate can be stated very simply. Foulke (1964) found that the average braille reader can process braille at the rate of 104 words per minute. For a group of eighth grade blind subjects without additional handicaps, their braille reading rate was found to be 150 words per minute.

(Lowenfeld, Abel, Hatlen, 1969). Word rate can be improved through the use of recorded materials which have been read aloud. Reports of oral reading rate have ranged from 150 to 175 words per minute.(Bocca and Calearo, 1963; Goldstein, 1940; Johnson et al. (1963); Nichols and Stevens, 1957). However, neither of these methods approximates the average word rate of the silent visual reader of 250 to 300 words per minute (Harris, 1947; Taylor, 1937).

Methods of Speech Compression

Foulke (1969) analyzed six methods of speech compression. The simplest method requiring no special device is to pace the oral reader at a faster rate. However, one cannot maintain this pace for long without an increase in articulation errors and loss of inflection (Kozhevnikov and Chistovich, 1955). Another simple method of attaining speech compression is to play back a tape or record at a faster speed than the speed at which it was recorded. Within certain limits, this has been found to be satisfactory, but it does introduce pitch distortion and a loss of voice quality (Fletcher, 1929; Foulke, 1966; Garvey, 1963a,b; Gore, 1968; Klumpp and Webster, 1961; Kurtzrock, 1957; McLain, 1962; Nixon, et al., 1968; Nixon and Sommer, 1968).

Compression by the sampling technique, whereby instantaneous segments of the speech sound are alternately retained and discarded, and the retained samples joined to form continuous speech, can be achieved by means of a computer (Cramer, 1968; Scott, 1963). Scott and Gerber (1971) describe dichotic speech, another form of compressed speech using the computer. Speech segments which would normally have been discarded are now joined to form continuous speech are fed through earphones to the other ear simultaneously. Though highly satisfactory, both of these methods are currently impractical because of the high cost of computer time. The American Foundation for the Blind jointly with Bell Telephone Laboratories undertook the development of a harmonic compressor. The experimental prototype was completed in 1968 (Breuel and Levens, 1971). Its main disadvantage is that it is limited to compressions of 50 percent.

The sixth method of compression is an electromechanical device developed by Fairbanks, Everitt, and Jaeger and announced in 1954. It was later modified by Graham (1971). This sampling device has the capacity for discarding samples 20 to 40 milliseconds long while retaining samples 20 to 80 milliseconds in duration. The retained samples are

then joined to form a continuous pattern. Because the discard sample is so short, no speech sound critical to the intelligibility of the word is ever fully discarded. Amounts of compression can be controlled and varied without a distortion in voice pitch or quality. For purposes of this study, the electro-mechanical sampling technique for compression is most appropriate. Thus, when compressed materials are referred to later, it should be understood that the materials have been compressed by this method.

Historical Development of the Electro-mechanical Compressor

Miller and Licklider (1950) were interested in the intelligibility of interrupted speech. They found that the spoken word could be understood when it was turned on and off as slowly as ten times a second. Garvey (1953b) reasoned that if the "off" portions of the interrupted speech could be discarded, and the "on" portions abutted in time, the result would be intelligible compressed speech, free of pitch distortion. Using a recorded tape, he painstakingly cut and spliced to remove the "off" portions, and demonstrated that the resulting compressed speech was indeed intelligible. His method, however, was too cumbersome for anything but research purposes. Then Fairbanks *et al.* (1954), announced the development of

their electro-mechanical apparatus for the compression and expansion of speech. This development stimulated many to consider the possibility that blind readers could more nearly approximate the reading rate of the silent visual reader.

Intelligibility and Comprehension as a Function of Word Rate

1. Compression and Intelligibility. With his splicing technique, Garvey (1953b) found that when a list of words was compressed to 40 percent of its original time, there was only a ten percent loss in intelligibility. Kurtzrock (1957), using the electro-mechanical compression device, found a 50 percent loss in intelligibility when a list of words was compressed to 15 percent of its original time. Fairbanks and Kodman (1957) compressed a similar list of words to 13 percent of the original time and found 57 percent intelligibility. The latter investigators also discovered a substantial loss in intelligibility when the duration of the discard sample exceeded 80 milliseconds.

2. Relation of Intelligibility and Comprehension of Compressed Speech. Foulke and Sticht (1967) presented materials to subjects at five different compressions. Though both intelligibility and comprehension declined as the compression increased,

comprehension declined more rapidly than intelligibility. This study suggested that there are other factors in addition to intelligibility which affect the degree of comprehension. They hypothesized that the perceptual and cognitive processes required for comprehension depend on a time factor needed for the registration and assimilation of input data. (Compare Overmann, 1971).

3. Compression and Comprehension. Diehl *et al.* (1959) found that, for word rates bounded by 126 and 272 words per minute, listening comprehension was unaffected by changes in compression. Fairbanks *et al.* (1957a) found little difference in listening comprehension when materials were presented to college students at 141, 201, and 282 words per minute. However, comprehension dropped rapidly with compressions beyond 282 words per minute. Foulke *et al.* (1962) used both literary and scientific selections with blind subjects and found comprehension through reading by listening to be only slightly affected by increasing word rates between 175 and 272 words per minute. They also found an accelerating loss in comprehension above 275 words per minute. Foulke and Sticht (1967) found a six percent loss in comprehension between 225 and 215 words per minute and a 14 percent loss between 325 and 425 words per minute.

Other studies report similar findings (Foulke, 1968a; Harwood, 1955; Langford, 1968; Nelson, 1947; Woodcock, 1971).

4. Index of Learning Efficiency. Simple scores in comprehension and word rate do not take into account the time saved in reading by listening. An index of learning efficiency was defined as the comprehension score divided by the time required for the listening task. Fairbanks et al. (1957a), Enc and Stolurow (1960), Foulke et al. (1962) found, in their respective studies, that this index of learning efficiency increased with compression until a word rate of approximately 280 words per minute was reached.

On another dimension of learning efficiency, Enc and Stolurow (1960), Friedman et al. (1966), and Foulke (1966) were concerned with the relationship between word rate and retention. They concluded that word rate had no special effect on the rate at which forgetting occurred.

Comprehension of Compressed Speech as a Function of Listener Variables

1. Age of Listener. Fergen (1955), Wood (1965), and Foulke (1969) found a positive relationship between the age or grade of a child and his ability to

comprehend accelerated speech. However, primary age children were able to respond successfully to short imperative statements which had been compressed.

2. Intelligence. Wood (1965) found no relationship between the IQ of primary age children and their ability to respond to instructions which had been compressed. Fergen (1955) found no relationship between the IQ of grade school children and their ability to comprehend accelerated speech. deHoop (1965) and Engman (1970) found that moderately compressed materials could be used with mentally retarded students without a significant loss in comprehension. (Compare Napier, 1971). Woodcock (1971) reported that the IQ, when mental age is held constant, does not seem to be an important variable. On the other hand, when working with adults, Fairbanks, *et al.* (1957a, b), Goldstein (1940), and Nelson (1947) did find a positive relationship between IQ and ability to comprehend compressed speech. These studies offer no conclusive evidence about the relationship between IQ and reading by listening to compressed speech.

3. Print Reading Rate. Jesters and Travers (1965) had subjects read print or read by listening to normal recordings at similar word rates. For both reading print and reading by listening, comprehension declined as word rate increased. However, up to a rate

of 200 words per minute, reading by listening yielded better comprehension scores than did reading print. Also Goldstein (1940), Orr, Friedman and Williams (1965) found a positive correlation between the subject's print reading rate and his ability to comprehend compressed speech.

4. Visual Status. Hartlege (1963) found that blind and sighted subjects did not differ significantly with respect to listening comprehension at a normal word rate. However, Foulke (1964a) found that blind subjects could comprehend compressed speech better than sighted subjects. This is probably due to the fact that the blind subjects were accustomed to reading by listening.

Comprehension as a Function of the Level of Difficulty of the Compressed Material

Formulae for the absolute difficulty of a reading selection have been developed by Dale and Chall (1948) and Flesch (1948). However, these formulae were developed for print reading. For lack of anything better, Foulke, et al. (1962) used one of these formulae to equalize the literary and scientific materials used. However, the subjects found the scientific selections more difficult to listen to than the literary material. Fairbanks, et al. (1957a), using five categories of difficulty, and George (1969)

found listening comprehension not to be a function of the difficulty level of the material.

Comprehension of Compressed Speech as a Function of Training.

Vorr and Miller (1965) exposed subjects to five listening selections compressed to 380 words per minute. Listening comprehension improved from the first to the third selection, but not thereafter. Woodcock (1971) reported a similar finding. Perhaps this demonstrates a simple adjustment to accelerated speech. Orr, Friedman and Williams (1965) found a 29.3 percent improvement in comprehension of material compressed to 475 words per minute following several weeks of training. Kleinman (1963), Napier (1971), and Rawls (1971) also found an improvement in listening to compressed speech after training had occurred. Foulke (1964) used materials compressed up 350 words per minute with blind subjects. He found no significant difference in tests of comprehension given before and after training. Other studies include Fairbanks, _et al_. (1957b), Friedman, _et al_. (1966). It is apparent that thus far no adequate, effective training program has been developed for improving comprehension of compressed speech.

The Relationship Between Print or Braille Reading and Reading by Listening

> Do we learn more efficiently by listening or by reading? The answer, were it known, would be of prime importance to the educator as well as all others who seek to instruct, influence or convince others. Psychologists have sought this answer for over 70 years and are still pursuing it. A vast literature has grown up, but any definite answer has failed to appear (Duker, 1966, p. 399).

1. Intelligence. Print reading was found to be more effective than listening for subjects with higher IQ and better reading ability. Green (1934) after using both modalities to present psychological material to college students, found that reading print was superior for students who ranked in the upper quartile in reading ability and listening was superior for students in the lowest quartile. Davy (1971) found that high school students with reading problems had a significantly higher level of comprehension from listening to tape-recorded speech at normal speed than from reading equivalent printed material for an equal length of time.

2. Retention. For immediate recall, visual mode is favored. For delayed recall, auditory mode is favored. Corey (1934) using audio materials of 100 words per minute, with college freshmen, reported that

the visual mode was better for immediate recall. However, after a few wekks, Corey found no significant difference.

3. Grade Level. For students below the seventh grade, listening is consistently reported as superior to reading due to the fact that reading skills have not yet been fully developed (Day and Beech, 1966; Haberland, 1956; Lumley, 1933). Young (1930) studied 2,000 children in the fourth, fifth, and sixth grades. The auditory mode was significantly superior at the fourth grade, but only slightly superior at the sixth. Reading print was found to be superior above the seventh grade (Cody, 1962; Haugh, 1950; Russell, 1928). Caughran (1953) suggested that mental age is more reliable than chronological age or grade level to determine the relative superiority of reading print to reading by listening. He reported reading print superior above a mental age of 13.5.

4. Difficulty of Reading Material. With respect to level of difficulty of the material, Larsen and Feder (1940) found that for 150 university freshmen, reading print was increasingly superior to reading by listening as the level of difficulty increased. Carver (1934) tested 91 college students and adults. Listening was superior for the easier material.

"Meaningful familiar material is more efficiently

presented aurally whereas meaningless and unfamiliar material is more efficiently presented visually" (Day and Beech, 1966, p. 402).

5. Braille Reading and Listening. It is uncertain if the relationship between print reading and listening is maintained for braille reading and listening. Nolan (1966) presented scientific, literary, and social studies materials to blind students in grades seven to ten. When the same amount of time was utilized, learning by listening to normal recordings was found to be more efficient than learning by braille. When comparing braille with Talking Books, Lowenfeld (1945) found that though braille was better for most students, Talking Books yielded relatively high comprehension scores for low IQ blind children in grades three through seven.

6. Correlations Between Reading and Listening. "In respect to the relationship between listening ability and reading ability, correlations ranging from low to relatively high now make a positive relationship doubtful" (Keller, 1966, p. 149). Goldstein (1940) reported a correlation of .78. Similar high correlations were found by Bonner (1960), Evertts (1961), Holmes and Singer (1961), and Toussaint (1961). Using a procedure for testing listening comprehension which did not involve reading,

Blewett (1949) found the correlation between print reading and listening to be .35. Other studies have likewise found low correlations between reading print and listening (Baldauf, 1960; Brown and Carlsen, 1966; Stromer, 1952). Correlations between braille reading and listening for third to seventh graders ranged between .56 and .76 (Lowenfeld, 1945).

Summary

Of the three reading media, braille, normal recording, and compressed speech, braille is the slowest and compressed speech is the fastest. Some studies have compared reading by braille with reading by listening to normal recording, suggesting that, though more is comprehended through the former, the latter is more efficient. Other studies have compared reading by listening to normal recording with reading by listening to compressed speech. As the word rate of compressed speech is increased, comprehension declines more rapidly than intelligibility. An optimum rate for students of average or above average ability appears to be 275 words per minute. However, the optimum rate for below average students seems to be 250 words per minute. There was no conclusive evidence regarding the effectiveness of a training program in the use of compressed speech.

The relative superiority of reading print to reading by listening is undetermined. With respect to comprehension, half of the research studies favor the visual mode while the other half favor the auditory mode (Day and Beech, 1966). When controlling for amount and difficulty of material and age of subject, there is a moderate to low correlation between the two media. This suggests that some students read either print or braille better than they read by listening, while for others the reverse would be true.

Chapter III

Statement of Hypotheses

This study seeks to identify the following four levels of blind subjects between 14 and 21 years of age:

I. High braille readers, high listeners
II. High braille readers, low listeners
III. Low braille readers, high listeners
IV. Low braille readers, low listeners.

This study seeks to compare the three reading media, braille (B), normal recording (N), and compressed speech (C), within each of the above levels and overall levels. The following null hypotheses will be tested:

A. For overall subjects, there will be no difference in the index of learning efficiency.

1. Between reading by braille and reading by normal recording.

   $M_B - M_N = 0$

2. Between reading by normal recording and reading by compressed speech.

   $M_N - M_C = 0$

3. Between reading by braille and reading by compressed speech.

$$M_B - M_C = 0$$

B. For the high braille readers who are high listeners (Level I), there will be no difference in the index of learning efficiency.

1. Between reading by braille and reading by normal recording.

   $$M_{B_1} - M_{N_1} = 0$$

2. Between reading by normal recording and reading by compressed speech.

   $$M_{N_1} - M_{C_1} = 0$$

3. Between reading by braille and reading by compressed speech.

   $$M_{B_1} - M_{C_1} = 0$$

C. For the high braille readers who are low listeners (Level II), there will be no difference in the index of learning efficiency.

1. Between reading by braille and reading by normal recording.

   $$M_{B_2} - M_{N_2} = 0^{*}$$

2. Between reading by normal recording and reading by compressed speech.

   $$M_{N_2} - M_{C_2} = 0$$

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[*] The result of this contrast must be qualified as it is closely associated with the grouping procedures.

3. Between reading by braille and reading by compressed speech.

$$M_{B_2} - M_{C_2} = 0$$

D. For the low braille readers who are high listeners (Level III), there will be no difference in the index of learning efficiency.

1. Between reading by braille and reading by normal recording.

$$M_{B_3} - M_{N_3} = 0^*$$

2. Between reading by normal recording and reading by compressed speech.

$$M_{N_3} - M_{C_3} = 0$$

3. Between reading by braille and reading by compressed speech.

$$M_{B_3} - M_{C_3} = 0$$

E. For the low braille readers who are low listeners (Level IV), there will be no difference in the index of learning efficiency.

1. Between reading by braille and reading by normal recording.

$$M_{B_4} - M_{N_4} = 0$$

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*The result of this contrast must be qualified as it is closely associated with the grouping procedures.

2. Between reading by normal recording and reading by compressed speech.

$$M_{N_4} - M_{C_4} = 0$$

3. Between reading by braille and reading by compressed speech.

$$M_{B_4} - M_{C_4} = 0$$

Chapter IV

Definition of Concepts or Variables

Visual status: Blind children refers to those who use braille as their mode of reading.

Word rate:

1. Reading rate of print or braille is defined as the number of words read per minute.
2. Moderate compression is defined as approximately 250 words per minute or 30 percent to 35 percent compression.

Four groups of subjects are defined as follows:

1. The high braille readers who are high listeners are those subjects who score above the median on braille comprehension and normal recording comprehension.
2. The high braille readers who are low listeners are those subjects who score above the median on braille comprehension and below the median in normal recording comprehension.
3. The low braille readers who are high listeners are those subjects who score below the median on braille comprehension and above the median in normal recording comprehension.
4. The low braille readers who are low listeners are the subjects who score below the median

in both braille comprehension and normal recording comprehension.

Reading: Reading is defined as the recognition, interpretation and assimilation of the ideas represented by symbolic material whether displayed visually, aurally, or tactually.

Comprehension: Reading comprehension in braille, normal recording or compressed speech is to be measured by a multiple-choice objective test of some reading selections in the Reading Versatility Test (McDonald, 1968) which gives subscores in:

1. Reading for general information.
2. Reading for detailed information.
3. Skimming for main ideas.
4. Scanning for a specific idea.

Time Spent on the Reading Task: This term is defined as the amount of time a student spends on the reading selection, not including the time spent answering the questions. This time is to be measured to the closest ten-second interval.

Index of Learning Efficiency: This term is defined as comprehension score per unit of time. The comprehension scores for each medium will be divided by the number of minutes spent on the reading task to give an index which ranges between 0.0 and 3.0.

Chapter V

Preparation of Materials

As will be noted in Chapter VI, the procedures for this reading study are divided into four parts: Preliminary Phase, Selection of Test Instrument and Securing District Cooperation; Phase One, Securing Parental Permission; Phase Two, Exposure to Compressed Speech; and Phase Three, Administration of Reading Tests. The preparation of materials will be described as they apply to each phase.

Preliminary Phase

Selection of Test Instrument: The reading test utilized to compare reading by braille, reading by listening to normal recording and reading by listening to compressed speech was, of necessity, an adaptation. There were no tests available designed for those specific media. The following factors had to be considered in the selection of a reading test to be adapted.

1. The test would be used with children 14 through 21 years of age, having a wide range of abilities.
2. A minimum of three equivalent forms of the test would be needed since each child would be asked to take one form in braille, another

in normal recording and a third in compressed speech.

3. Since each student would be taking three different forms of the same test, it had to be long enough to adequately sample reading behavior, but short enough to prevent undue fatigue.
4. The test would need to include in its measure samples of a variety of reading tasks, not simply reading for main ideas as in reading fiction.
5. Since subjects would be asked to complete each reading selection, a timed power test would be inappropriate.
6. The focus of the study was a comparison of the three reading media nested within the subjects. As a result, a criteria referenced test rather than a norm referenced test was suggested.

After reviewing currently available tests, some were found to be oriented to the college bound, some sampled only one type of reading, some were too long, etc. The test which most nearly met all of the above criteria was the Reading Versatility Test published by the Educational Development Laboratory (McDonald, 1968).

The Reading Versatility Test, Intermediate Level, is for students in grades 8 through 12. It has four equivalent forms; A, B, C, and D. According to the test constructors,

> a flexible reader is one who is effective in achieving his purpose for reading and efficient in accomplishing this task with a minimum of expenditure of psychological and physiological effort (McDonald, 1968, p. 3 of Manual).

To measure versatility, the test includes the following kinds of selections:

> 1. A fiction selection which the reader is directed to read as if time were short, but with attention directed to important facts, main ideas, and implications.
>
> 2. A nonfiction selection requiring careful, thoughtful reading with attention to detail, main ideas, and implications.
>
> 3. A selection which the reader skims in order to answer questions dealing only with the more important ideas.
>
> 4. A selection which the reader scans to enable him to answer a question provided in advance.
>
> The reading for each selection is timed and, since the reader is directed to take as much time as he needs, the resulting rate measurements and the ratio of rates among the parts provide indications of reading efficiency (McDonald et al., 1968, p. 3 of Manual).

With respect to the reliability of the Reading Versatility Test, Intermediate Level, the manual reports a correlation of .84 for Part 1, .80 for

Part 2, and .51 for Parts 3 and 4 on back-to-back administrations of alternate forms. The last lower correlation was attributed to the number of nonskimmers and nonscanners included in their sample.

With respect to validity, the reading selections were carefully controlled across the four forms for interest and style. Both the Flesch and Dale-Chall formulae were used to control for level of difficulty. "The number of words in a given part in each form ... is the same as are the number of sentences, syllables and overgrade words (McDonald, et al., 1968, p. 10 of Manual)." Appropriate parts of the Reading Versatility Test correlate favorably with other reading tests such as the Diagnostic Reading Test, Cooperative Reading Test, Davis, McGraw-Hill, and Nelson Denny (McDonald et al., 1968; Maxwell, 1971).

Securing Cooperation of Local School Districts in California: A brief summary of the Study (Appendix I) and two letters were prepared for the purpose of securing the cooperation of local school districts in California. The first letter (Appendix II) along with the summary was mailed to district superintendents and directors of special education. If district administrators granted permission, the second letter (Appendix III) was sent to the resource or itinerant

teacher of the visually handicapped to secure their cooperation.

Phase One: Securing Parental Permission

A form was prepared (Appendix IV) to inform the parents of the nature of the project and to secure their permission to include their children in the study. Included in this letter was the promise that each subject participating in the project would receive a copy of a book in compressed speech.

Phase Two; Exposure to Compressed Speech

As reading by listening to compressed speech is a relatively new medium, compressed speech materials had to be prepared and distributed to each subject. Five 20 minute reading selections were chosen representing a variety of interests and compressions as follows:

1. Science fiction: 25 percent compression, taken from Jules Verne's *From the Earth to the Moon*.
2. Historical: 25 percent compression, taken from the state history text, *Land of the Free*, by Caughey *et al*. (1967).
3. Mystery: 35 percent compression, taken from Earl S. Gardner's *The Case of the Beautiful Beggar*.

4. Biography: 35 percent compression, taken from Arthur Hann's Sandy Koufax.

5. Short story: 30, 40, and 50 percent compression, taken from Merritt Allen's Two Chests of Treasure. (The beginning at 30 percent, the middle at 40 percent, and the end at 50 percent compression).

Three multiple choice questions were prepared by this investigator for each of the above reading selections (Appendix V). They were read by a female voice onto the tape following the reading selection. These questions were used to motivate each subject to complete the reading of each selection. They also provided a self-evaluation guide for the subjects.

Fifty copies of each of these reading selections, with accompanying questions, were duplicated at the University of California Language Laboratory, Berkeley. These tapes maintained the conventional 2-track, 3 3/4 ips on five-inch reels.

Phase Three: Administration of Reading Tests

Preparation of Tests: The Reading Versatility Test, Intermediate Level, Forms A, B, C, and D, were all transcribed into each medium: braille, normal recording and compressed speech. Peninsula Braille Transcribing Group, San Mateo, California, brailled

the masters and reproduced 30 copies of each of the four forms, giving a total of 120 braille test pamphlets. The Perceptual Alternatives Laboratory, University of Louisville, produced the normal recording and compressed speech masters for each of the four forms. The instructions and the reading selections were read by a professional male reader. The 2800 words of the reading selections for each of the forms took an average of 17.3 minutes for normal recording and 11.0 minutes for compressed speech. The questions, each read twice, were read by a professional female reader. For the compressed speech version, only the reading selection was compressed to a rate of 250 words per minute, the instructions and the questions remaining in normal speech. The Language Laboratory at the University of California at Berkeley, reproduced 25 copies of each of the eight masters, the four forms in normal recording and in compressed speech. This had to later be supplemented with five copies of each, reproduced by this investigator by the use of two tape recorders, thus making a total of 120 tests in normal recording and 120 tests in compressed speech.

These recorded materials were also reproduced at 3 3/4 ips on 2-track, 5 inch reels. A tone beep was inserted on all masters between each reading selection

and the beginning of the questions for that selection.

Practice Sheet for Braille Test: A practice sheet was prepared to orient students to the expected mode of response (Appendix VI). The braille questions were to be answered in the test manual. The student was asked to place the index finger of one hand on the letter of his choice and, with a pencil in the other hand, draw a line under that letter.

Practice Sheet and Answer Sheets for Recorded Test: For the recorded tests, a pencil mark was to be placed in the box next to the letter chosen. The practice sheet offered two sample questions for students' use (Appendix VI). The answer sheet for the taped tests (Appendix VII) consisted of a three-page thermoformed answer sheet with the ten questions for Part 1 on the first page, ten questions for Part 2 on the second page, and the four questions for Parts 3 and 4 on the third page.

Materials Packages for Each Student: A packet was prepared for each student which included a braille test, a normal recording test with answer sheet, a compressed speech test with answer sheet, a practice sheet, and a Student Data Sheet. The student's identification number was put on the packet envelope, braille test, normal recording answer sheet, compressed speech answer sheet and the student data sheet. The

boxes which were packed for each teacher included his students' packets, a print copy of the Reading Versatility Test and the instructions for test administration.

Student Data Sheet: Though the primary focus of the study was to analyze the index of learning efficiency for different groups of children among the three media, knowledge of some other variables would help in interpreting final results. A Student Data Sheet was prepared (Appendix VIII) which sought answers to variables such as; age, grade, number of additional handicaps, amount of vision, number of years blind, number of years of braille instruction, number of hours spent per day reading by braille and by listening and media preference.

Instructions for Test Administration: The test manual provided with the Reading Versatility Test had to be adapted for the braille and recorded media. The instructions described the student test packets, the additional materials needed, outlined the use of the practice sheets, and specified each step required in the testing procedure (Appendix IX). Due to the wide geographical distances, this investigator had to rely on local personnel to administer the tests. Uniform procedures had to be outlined and maintained. Several students who were not included in the testing

sample, offered to take the test to insure the clarity of the instructions and the use of the test materials. No problems were encountered. Several suggestions were offered and the instructions were altered accordingly.

Chapter VI

Research Design and Methodology

Population and Sampling Procedures

This study was limited to blind students, age 14 through 21, who reside in California. By the time students are 14 years of age, they have had sufficient opportunity to develop both braille and listening skills that would prevent a bias in either direction.

For statistical purposes, it was necessary to secure 100 subjects. School districts in California who have greater numbers of blind students within this age bracket were contacted and their cooperation sought. If granted, the inclusion of a subject into the study was dependent upon his willingness (and the willingness of his parents) to be included in the project.

An effort was made to include children with a wide range of abilities. There was no exclusion of children with additional handicaps. Consequently, both children from residential schools and public schools were included.

Detail of Procedures

The objective of this study was to compare three reading media; braille, normal recording and compressed speech. Subjects were asked to take three equivalent

forms of the Reading Versatility Test, Intermediate Level, a different form for each medium. The study proceeded through the following phases: Preliminary Phase: Securing Cooperation of Local School Districts in California and Selection of Test Instrument; Phase One: Securing Parental Permission; Phase Two: Exposure to Compressed Speech; and Phase Three: Administration of Reading Tests.

Preliminary Phase: Securing Cooperation of Local School Districts in California and Selection of Test Instrument: With the help of the California State Department of Education Consultants for the Visually Handicapped, the districts with the larger resource and itinerant programs for visually handicapped students were identified. Letters of inquiry (Appendix II), along with a summary of the proposed study (Appendix I), were sent to the District Superintendent and the Director of Special Education. Of the 46 districts contacted, 32 granted permission, while seven indicated that they had no braille students age 14 through 21.

When district permission was granted, a letter (Appendix III) was sent to the resource or itinerant teacher of the visually handicapped. The small numbers of subjects available, and the wide geographical distances required to find an adequate sample, necessitated

working through the resource and itinerant teachers. They were asked not only to enlist willing subjects but also to help distribute materials and administer tests. Through them, 150 subjects were identified as willing to participate in the project.

The procedure used to choose an appropriate reading test has been described in full in a preceeding chapter.(pages 30-33).

Phase One: Securing Parental Permission: Through the resource and itinerant teachers, a letter (Appendix IV) was sent to the parent or guardian of each subject. After explaining the nature of the project, permission was sought to include their child in the study. Furthermore, the parents or guardinas were assured that they, themselves, would not be actively involved in the study.

Phase Two: Exposure to Compressed Speech: Since compressed speech is a relatively new reading medium, it was unlikely that the subjects would have had any previous experience with reading by listening to compressed speech. The next step in the project involved sending to the teachers multiple copies of the five 20 minute compressed speech reading selections described in the previous chapter (pages 34 & 35). Since the review of the literature indicated that no significant gains in comprehension occured after three exposures to

compressed speech, it was felt that the five 20 minute selections were sufficient to orient the students to this mode of reading.

The subjects were asked to listen to all five selections and to answer the three multiple choice questions for each. The questions were used to motivate the students to read each selection completely and to provide a self-evaluation guide. These results did not enter into the statistical analysis.

The reading selections provided the subjects with exposure to a variety of compressions ranging from 25 percent to 50 percent, thus providing some exposure to compressions exceeding that of approximately 35 percent utilized on the Reading Versatility Test. It was assumed that this would help prevent a strange or strained testing situation.

Phase Three: Administration of Reading Tests: Following the exposure to compressed speech, each subject was asked to take three equivalent forms of the Reading Versatility Test; one form in braille, another form in normal recording and a third in compressed speech. The resource or itinerant teacher was sent a test packet for each of his students in the project. The test packet included instructions, braille test, normal recording test with answer sheet, compressed

speech test with answer sheet, a practice answer sheet and a student data sheet. The packet and contents were coded with an identification number. The student data sheet specified the form and order of the three tests.

Care was taken to distribute the effects of form and order among the three media. Though the four equivalent forms of the Reading Versatility Test had been standardized on print readers, there was no guarantee that their equivalency was maintained in a different reading medium. Therefore, a quarter of the braille tests was assigned in each of the four forms, A, B, C, and D, and similarly for normal recording and compressed speech. Furthermore, since all of the forms are identical in format, it could be assumed that the experience of taking the first test could affect the results of subsequent tests. To equalize this practice effect, a third of the students were assigned braille, first; a third, normal recording, first; and a third, compressed speech first. (See Appendix IX for a listing of the rotation of form and order.)

Each test contained four reading selections and 24 multiple choice questions. It was hoped that the tests would reflect normal reading habits. Therefore, the students were permitted to reread or retrace any

of the reading selections, whether braille, normal recording or compressed speech, as long as they did so before they began answering the questions. A record was kept of the time spent reading the selections, not including the time spent answering the questions. For the convenience of the resource and itinerant teachers, a limit of 60 minutes was suggested. According to Lowenfeld, Abel, and Hatlen (1969) this was more than ample time.

To orient the subjects to the response mode expected for answering the multiple choice questions, they were asked to answer four questions on a practice sheet. Two of the questions illustrated the braille format in which the student was expected to place a pencil mark under the letter of his choice. The other two questions illustrated the response mode expected in answering the recorded questions. Using prepared answer sheets (Appendix VII), they were asked to place a pencil mark in the box next to the letter of their choice.

The resource or itinerant teacher was asked to complete the student data sheet giving student's age, grade, number of additional handicaps, amount of vision, number of years blind, number of years of braille instruction, number of hours spent per day reading by braille and by listening and media

preference. The student data sheet also contained a list of eight books available in compressed speech. As compensation for participating in the project, each student could choose one title which he would most like to have.

When the completed tests were returned to the investigator, they were scored by hand. A comprehension score (the number of correct responses) and a time (to the closest ten-second interval) were recorded for each student in each medium. Of the 150 tests distributed, 121 were returned, with 104 of these having been completed satisfactorily.

Procedures for the Statistical Analysis

Four groups of subjects were identified on the basis of their braille comprehension scores and their normal recording comprehension scores. The braille comprehension scores and the normal recording comprehension scores were independently ranked and their respective medians determined. Subjects who scored above the median in both media formed one level, while those who scored below the median in both, formed another level. Those who scored above the median in one and below the median in the other formed the other two levels. The following matrix presents the label and numeric breakdown for each group.

		Normal Recording Comprehension		
		High	Low	Total
Braille Comprehension	High	I(39)	II(13)	(52)
	Low	III(13)	IV(39)	(52)
	Total	(52)	(52)	104

Most educators have assumed that a high braille reader is also a high listener, and a low braille reader is also a low listener. It is interesting to note that a quarter of the high braille readers learned significantly more through reading by listening to either normal recording or compressed speech (Level II). A quarter of the low braille readers learned significantly more through reading by listening to either normal recording or compressed speech than through reading by braille (Level III).

The resource and itinerant teachers were asked to complete a Student Data Sheet (Appendix VIII) for each of their students. The answers to these questions were compiled for each level and, when appropriate, averaged. They provided background and descriptive material to better understand the nature of the sample drawn.

An index of learning efficiency was then calculated

for each test by dividing the comprehension score by the time spent on the reading task. Three indices were calculated for each student, one for braille, one for normal recording and one for compressed speech.

Before testing the major hypotheses of the study, a preliminary analysis based on comprehension scores alone was performed. For each of the contrasts, B - N, N - C, and B - C, confidence intervals were computed using an analysis of variance procedure based on an assumption of homogeneity of variance across the levels. An alpha of .05 was distributed over all the contrasts utilizing Dunn's table, which is based on Bonferroni's inequality (Kirk, 1969). It must be remembered that the levels were identified on the basis of B and N comprehension scores. Therefore, the contrast B - N has no meaning other than that grouping procedures were effective. Some correlations were also computed for pairs of B, N, and C.

Finally, the major hypotheses were tested. Again, for each of the contrasts, B - N, N - C, and B - C, confidence intervals were computed using an analysis of variance procedure based on the assumption of homogeneity of variance across the four levels. An alpha of .05 was distributed over all the contrasts utilizing Dunn's table which is based on Bonferroni's inequality. Thus, the alpha for each contrast was controlled at

.0033. It must be remembered that, with respect to efficiency, one level has been preselected to favor reading by listening (i.e., Level III). Thus any findings which favor reading by listening for Level III can be credited in part to grouping procedures. Though Level II favors braille comprehension, the relative efficiency of braille to normal recording is undetermined since braille takes so much longer.

There are several other assumptions necessary for this analysis. It is assumed that the variables represent a normal distribution. A random normal variable such as comprehension scores divided by a random normal variable, such as time, is likely to produce a Cauchy (Feller, 1966) variable. A Cauchy variable has a non-normal, unpredictable distribution without a mean and without a variance. The indices of learning efficiency for each level and for all braille tests were plotted on arithmetic normal paper (Dixon and Massey, 1969) to determine how closely their distribution approximates the normal curve (Appendices XI and XII). Since the indices did approximate the normal distribution, it was concluded that, due to narrow limits on both time and comprehension, the hazards of a Cauchy variable had been avoided.

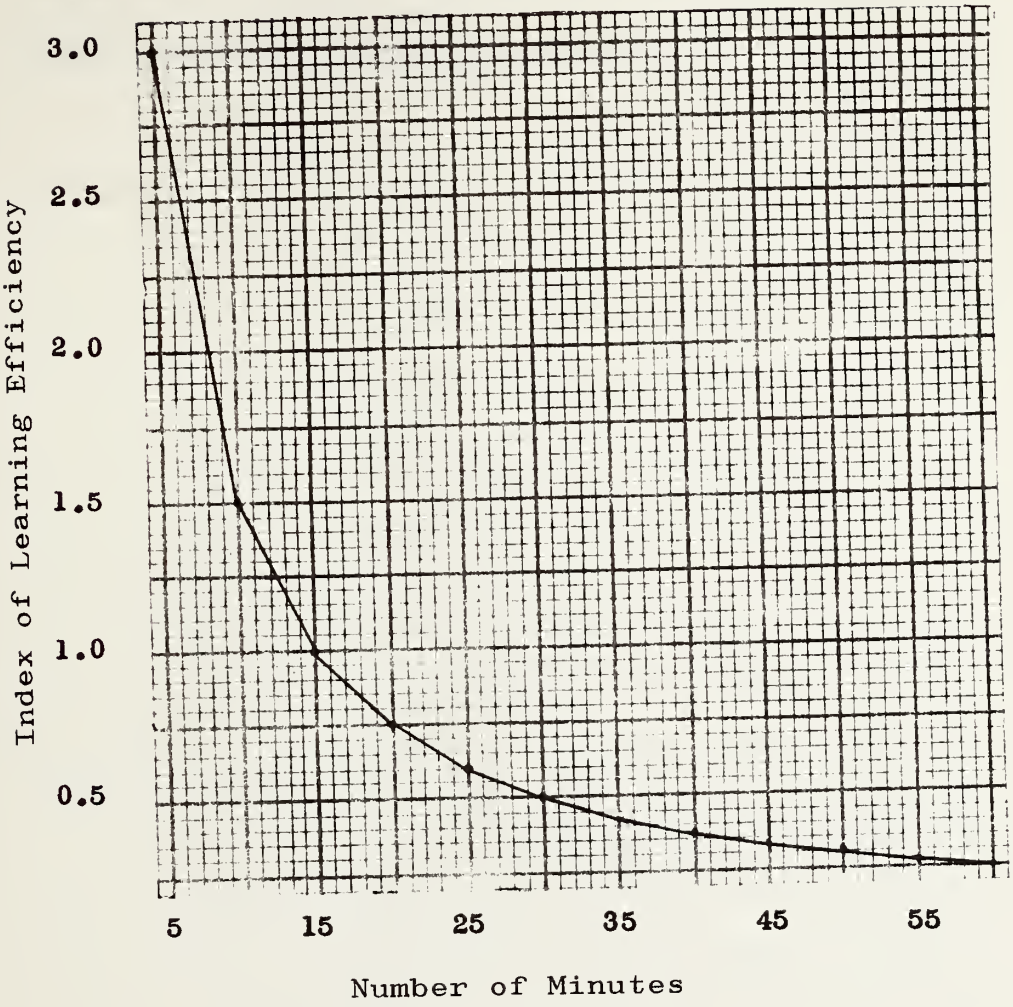
Another assumption is that the subjects included in this study represent a random sample. It must be

remembered that the number of blind subjects between 14 and 21 years of age in California is limited. Thus, this sample represents a greater proportion of the total available population than usual. Inclusion in the study was dependent on securing a positive response from each of the following: school district, teacher, student and parent. The assumption of randomization, as in so many educational research projects, is not fully satisfied. However, the form and order of administering the Reading Versatility Tests were randomly assigned to the subjects (Appendix X).

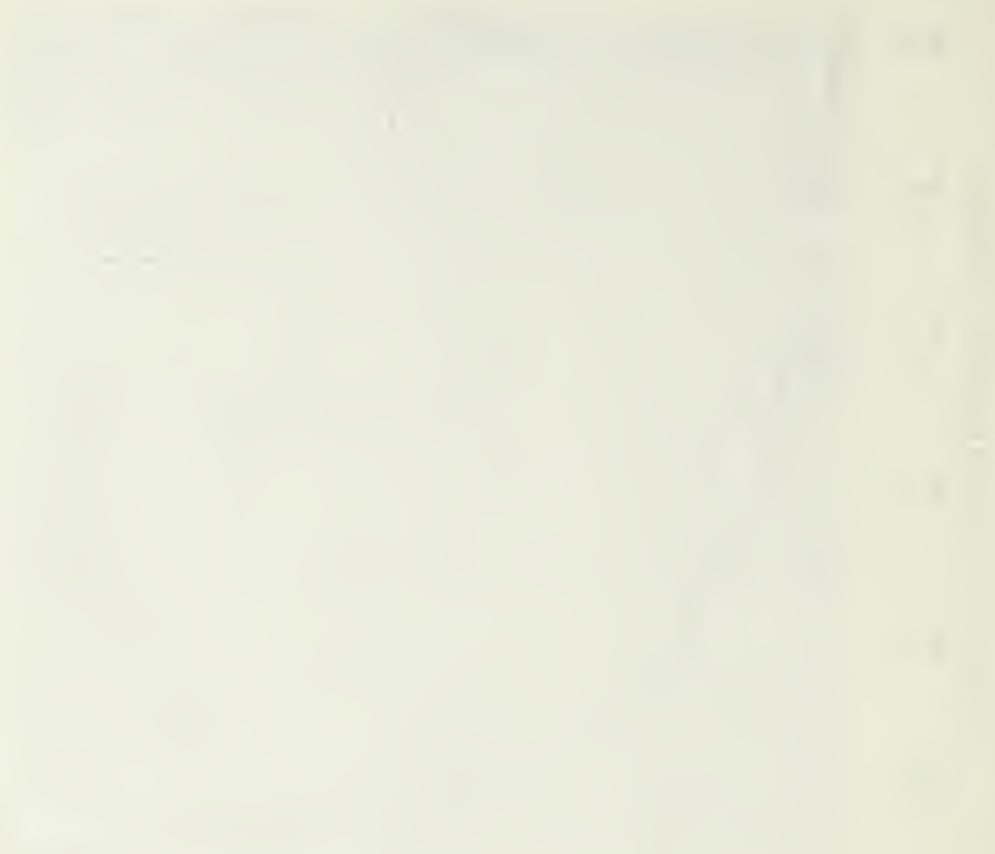
The last assumption required for this analysis is that the individual error term for each observation is independent of all others within each contrast across the four levels. Furthermore, it is assumed that these error terms are normally distributed.

The index of learning efficiency is a ratio of the type $Y' = Y/X$. This is a hyperbolic function. The following plot will serve to illustrate. Holding comprehension constant at the mean of 15, the index of learning efficiency has been plotted against time.

Index of Learning Efficiency as a Hyperbolic Function



Notice that the difference in indices between 5 and 10 minutes is not the same as the difference in indices for a similar 5-minute interval between 55 and 60 minutes. In order to achieve a more direct interpretation, it would be helpful to have these intervals more nearly equal. A commonly accepted transformation to flatten this hyperbolic function is to use the natural logarithm of the index. To test the major



hypotheses (Kirk, 1969), the log of the index of the learning efficiency was used in the analysis of variance procedure described above.

Chapter VII

Results

The purpose of this study was to compare three reading media, braille, normal recording and compressed speech. To achieve this end, blind subjects between the ages of 14 and 21 were asked to take three equivalent forms of the Reading Versatility Test, Intermediate Level, one in braille, another in normal recording, and a third in compressed speech. There were 104 subjects who satisfactorily completed the reading tests in all three media.

Through the use of medians, the following four levels were identified, with 39, 13, 13, and 39 subjects respectively:

I. High braille readers, high listeners.
II. High braille readers, low listeners.
III. Low braille readers, high listeners.
IV. Low braille readers, low listeners.

Description of Sample

In an effort to compile some qualitative information about the sample selected for this study, each resource or itinerant teacher was asked to complete a Student Data Sheet (Appendix VIII). Though the information thus gained is not apparent in the testing of the hypotheses (pages 24-27), it does provide a

basis for interpretation and speculation. The following summaries will reflect the differences, if any, which exist among the levels identified above.*

1. Age and Grade Placement: The subjects included in this study ranged from 14 through 21 years of age. There was no restriction in grade placement in the hope that the sample would reflect a wide ability range. It was assumed that the students reported as "ungraded" were having some academic problems. They were included in the averages as sixth graders.

Table 1

Age and Grade

Level	Mean Age	Mean Grade
I	17.3	11.6
II	16.5	10.4
III	16.8	10.6
IV	17.2	9.8
Overall	17.1	10.6

All subjects were braille readers, age 14 through 21, attending either California public schools (89 subjects) or the California School for the Blind, Berkeley (15 subjects). Subjects with additional

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*Summary information for students' media preferences and estimated time spent reading each day appear in Appendices XIII and XIV.

handicaps were not excluded.

2. Estimate of Subject's Mental Ability: Teachers were asked to rate their students either below average, average, or above average in mental ability. A few of the teachers did report an IQ score and the test instrument used. Those within plus or minus one standard deviation of 100 were considered to be average. The following table shows the distribution of these estimates for each of the four levels.

Table 2

Teacher's Estimate of Subject's Mental Ability

Level	Below Average		Average		Above Average		Total	
	%	n	%	n	%	n	%	n
I	0	(0)	49	(19)	51	(20)	100	(39)
II	31	(4)	38	(5)	31	(4)	100	(13)
III	8	(1)	46	(6)	46	(6)	100	(13)
IV	49	(19)	44	(17)	8	(3)	100	(39)
Total	23	(24)	45	(47	32	(33)	100	(104)

3. Subject's Visual Status: Subjects included in this sample were braille readers with varying amounts of vision. Some of them can also read print with difficulty. It was felt that braille skills would be weaker for those relying on dual modality of print and braille and for those recently blinded. It is

commonly assumed that the totally blind are the better listeners. The following tables summarize the number of subjects reported in each category of vision and number of years blind.

Table 3

Amount of Subject's Vision

Level	Totally Blind		Light Perception		Hand Movements		Reads Print w/Difficulty		Total	
	%	# n	%	n	%	n	%	n	%	n
I	59	(23)	31	(12)	5	(2)	5	(2)	100	(39)
II	77	(10)	23	(3)	0	(0)	0	(0)	100	(13)
III	54	(7)	8	(1)	23	(3)	15	(2)	100	(13)
IV	62	(24)	18	(7)	13	(5)	8	(3)	100	(39)
Total	62	(64)	22	(23)	10	(10)	7	(7)	100	(104)

Table 4

Number of Years Subject Has Been Blind

Level	Less than 3		3 - 10		More than 10		Total	
	%	n	%	n	%	n	%	n
I	0	(0)	10	(4)	90	(35)	100	(39)
II	0	(0)	0	(0)	100	(13)	100	(13)
III	15	(2)	0	(0)	85	(11)	100	(13)
IV	3	(1)	0	(0)	97	(38)	100	(39)
Total	3	(3)	4	(4)	93	(97)	100	(104)

4. Grade Level at Which Braille Instruction Began: It was assumed that the subject's braille skills would be a function of the number of years of braille

instruction. Those beginning braille instruction at the upper elementary or junior high grades would not have had the same opportunity to fully develop their braille skills. The following table shows the number of students who began braille instruction at the various grade levels.

Table 5

Grade Level at Which Braille Instruction Began

Level	K - 1		2 - 3		4 - 6		7 - 9		Total	
	%	n	%	n	%	n	%	n	%	n
I	72	(28)	10	(4)	13	(5)	5	(2)	100	(39)
II	92	(12)	0	(0)	0	(0)	8	(1)	100	(13)
III	62	(8)	23	(3)	8	(1)	8	(1)	100	(13)
IV	77	(30)	15	(6)	8	(3)	0	(0)	100	(39)
Total	75	(78)	12	(13)	9	(9)	4	(4)	100	(104)

5. Number of Additional Handicaps: Multihandicapped blind students were not excluded from this study. The teachers were asked to list any additional handicaps which their students had. It was felt that certain handicaps, such as a hearing loss or orthopedic handicap, might have a direct affect on either braille or listening skills. The following table summarizes the number of handicaps reported for each level. Since two or more additional handicaps were listed for six subjects, the column at the right shows

how many subjects were represented at each level.

Table 6

Number of Additional Handicaps

Level	A*	B*	C*	D*	E*	F*	Total	No. of Subjects n	No. of Subjects %
I	2	1	2	2	2	2	11	9	23
II	0	2	0	1	1	1	5	4	31
III	0	0	0	1	0	0	1	1	8
IV	2	1	3	13	6	4	29	20	51
Total	4	4	5	17	9	7	46	34	33

*(A, Hearing; B, Speech; C, Orthopedic; D, Emotional; E, Neurological; and F, Bilingual)

6. Subject's Ability to Use Tape Recorder: Since reading by listening to either normal recording or compressed speech involves the use of a tape recorder, the teachers were asked if the subjects knew how to operate a tape recorder. Subjects were permitted to reread or skip ahead in their reading. It was assumed that ability to operate a tape recorder was a prerequisite to the use of the tape recorder as an effective reading tool. The following table shows the number of students who were reported as being unable to operate a tape recorder. Nine of the 18 were also reported as having additional handicaps.

Table 7

Number of Subjects Who Cannot
Operate a Tape Recorder

Level I	0
Level II	1
Level III	0
Level IV	17
Total	18

7. Summary: The mean ages across the four levels did not vary more than .8 of a year. It is not surprising that Level I is 1.8 grade levels above Level IV even though their ages are the same. Comparing Levels II and III, poor skills in either braille comprehension or listening comprehension appear to have the same effect in grade placement.

As would be expected, most of the subjects were totally blind, had been blind for more than 10 years, and began braille instruction in kindergarten or first grade. It is interesting to note that there were 13 low braille readers and only four high braille readers who were reported as having "hand movements" or "reads print with difficulty." The assumption that the totally blind are the better listeners would suggest that more totally blind students would appear in Levels I and III than in Levels II and IV, remembering that Levels I and III are the high listeners, while Levels II and IV are the low listeners. The data

from Table 3 does not support this assumption. The subjects in Level III are those with more vision and tend to start braille instruction later than the subjects in Level II.

Teachers' estimates of mental abilities and teachers' reports of additional handicaps presented no surprises. Estimates of mental abilities tended to decrease from Level I to Level IV. However, the low braille readers, high listeners (Level III) received slightly higher estimates than high braille readers, low listeners (Level II). A majority of those reported with additional handicaps were to be found in Levels III and IV. Students with additional handicaps have additional learning problems.

Preliminary Analysis of Data

Before testing the major hypotheses (pages 24-27), it would be helpful to examine separately the two dependent variables, comprehension and time, which make up the index of learning efficiency.

1. Time: Each subject was permitted to take as much time as needed to read the selections upon which the questions were based. He was permitted to retrace or skip any of the material whether braille (B), normal recording (N), or compressed speech (C). The teachers were asked to keep a record of the number

of minutes spent on the reading task, not to include the time spent answering the questions.

The following table of means demonstrates the previously known fact that braille is the slowest medium while compressed speech is the fastest.

Table 8

Number of Minutes Spent on the Reading Task

Level	Braille (B)	Normal Recording (N)	Compressed Speech (C)
I	30.4	16.7	11.3
II	37.0	16.1	12.3
III	27.2	16.8	11.0
IV	32.8	17.3	11.2
Overall	31.8	16.9	11.3

2. Comprehension: For each of the three media, there were 24 questions to be answered. Ten questions were based on Part 1, reading for general information. Ten questions were based on Part 2, reading for detailed information. Three questions were based on Part 3, skimming for main ideas. Only one question was based on Part 4, scanning for a specific idea.

The following table gives the mean comprehension score for each medium at each level and overall levels.

Table 9

Comprehension Scores

Level	Braille (B)	Normal Recording (N)	Compressed Speech (C)
I	20.2	19.6	18.0
II	19.2	12.2	13.9
III	10.8	18.8	17.5
IV	11.4	10.5	11.5
Overall	15.6	15.2	15.0

Confidence intervals were computed across the four levels and overall for each of the contrasts: B - N, N - C, and B - C.

Comprehension scores of N and C did not differ significantly at any of the four levels. It is surprising to note that B - C was significant for Level I as well as Levels II and III. Yet, over all subjects none of the three contrasts was signficant.

Table 10

Confidence Intervals** for Comprehension Scores

Level	B - N	N - C	B - C
I	.54±1.87	1.62±1.84	2.15±2.05*
II	6.92±3.26*	-1.62±3.17	5.31±3.59*
III	-8.08±3.26*	1.31±3.17	-6.77±3.59*
IV	.87±1.87	-1.03±1.84	- .15±2.05
Overall	.38±1.60	.18±1.17	.57±1.57

(Confidence intervals noted by asterisk are significant)

**$CI = \hat{\psi} \pm t\hat{\sigma}_{\hat{\psi}}$ when $|t\hat{\sigma}_{\hat{\psi}}| < |\hat{\psi}|$, then the difference is statistically significant.

3. Correlation of Pairs of the Three Media: In the review of the literature, it was noted that correlations of print reading ranged from low to high. For both comprehension scores and index of learning efficiency, Pearson Product Moment Correlation coefficients were computed for B and N, for N and C, and for B and C.

Table 11

Correlation Coefficients

Comprehension

	B	N	C
B		.46	.45
N			.68

Index of Learning Efficiency

	B	N	C
B		.44	.40
N			.64

As might be expected, the correlations of reading by braille and reading by listening, whether N or C, are lower than the correlation of the two listening media, N and C. The moderate correlation of .46 of B and N made it possible to identify subjects who were high braille readers with low listening skills

(Level II) and subjects who were low braille readers with high listening skills (Level III).

4. Summary: On the average, braille took almost twice as long as normal recording and almost three times as long as compressed speech. Furthermore, within each level, the comprehension through reading by compressed speech was not statistically different from the comprehension through reading by listening to normal recording. Finally, though braille had a slightly higher overall mean comprehension of 15.6, there was no statistically significant difference in comprehension among the three media over all subjects .

Testing the Hypotheses

The major hypotheses test for differences in the index of learning efficiency among the three media across the four levels and overall levels. The index of learning efficiency was formed by dividing the comprehension score by the time spent on the reading task. The following table gives the mean number of correct responses per minute of time.

Table 12

Index of Learning Efficiency

Level	B	N	C
I	.83	1.19	1.65
II	.60	.76	1.18
III	.43	1.14	1.60
IV	.40	.62	1.05
Overall	.59	.92	1.36

For each of the contrasts, N - B, C - N, and C - B, confidence intervals have been computed across the four levels and over all levels. The natural logarithm of the index of learning efficiency was utilized for this analysis. The order of the variables in the contrasts have been reversed to present positive rather than negative numbers in the following table.

Table 13

Confidence Intervals** for Index of Learning Efficiency

Level	B - N	N - C	B - C
I	.46±0.33*	.30±0.18*	.77±0.33*
II	.26±0.54	.42±0.30*	.68±0.57*
III	1.31±0.54*	.32±0.30*	1.63±0.57*
IV	.50±0.33*	.51±0.18*	1.01±0.33*
Overall	.56±0.21*	.40±0.12*	.95±0.21*

*(Confidence intervals noted by * are significant)

**CI=$\hat{\psi} \pm t\hat{\sigma}_{\hat{\psi}}$ when $|t\hat{\sigma}_{\hat{\psi}}| < |\hat{\psi}|$, c then the difference is statistically significant.

All hypotheses were rejected except one. This study did not provide sufficient evidence to reject hypothesis with respect to N - B within Level II. In other words, within each level and overall, reading by listening to compressed speech was more efficient than reading by listening to normal recordings. Furthermore, for Levels I, III, IV, and Overall, normal recording was more efficient than braille. Only for Level II, those who are high braille readers with low listening skills, was there no statistically significant difference with respect to efficiency between reading by braille and reading by listening to normal recordings. No special significance can be given to the relatively narrow confidence intervals for the contrasts N - B and C - B of Level III since this was to be expected from the grouping procedures employed.

Conclusions

For braille readers having an average age of 17.1, having an average grade placement of 10.7, and attending schools in California, the conclusions can be summarized as follows:

1. Results of the grouping procedures demonstrated that the correlation between braille comprehension and normal recording comprehension is by no means

perfect. A quarter of the high braille readers (Level II) learned significantly more through reading by braille than through reading by listening to either normal recording or compressed speech. A quarter of the low braille readers (Level III) learned significantly more through reading by listening to either normal recordings or compressed speech than through reading by braille.

2. Over all subjects, there was no difference in comprehension among the three reading media: braille, normal recording, and compressed speech.

3. Over all subjects reading by braille took almost twice as long as reading by listening to normal recording and almost three times as long as reading by listening to compressed speech.

4. For each of the four levels, reading by listening to compressed speech was more efficient than either reading by braille, or reading by listening to normal recording.

5. Reading by listening to normal recording was more efficient than reading by braille for three of the four levels. There was no statistically significant difference in efficiency between reading by listening to normal recording and reading by braille for Level II, high braille readers who are low listeners.

6. Over all subjects, reading by listening to compressed speech was more efficient than reading by listening to normal recording which, in turn, was more efficient than reading by braille.

The above conclusions will be qualified in the next chapter. Suffice it to say here that the conclusions are based on only two aspects of reading behavior, comprehension and time spent on the reading task. Reading actually includes a wider range of activities than were represented in the prose selections of the Reading Versatility Test. Allied skills, such as spelling, punctuation, etc., were not examined. Nevertheless, this study does offer some evidence regarding the relative efficiency among the three media.

Chapter VIII

Implications

This study is among the first to compare all three reading media: braille, normal recording and compressed speech. Consequently, it suffers from a lack of knowledge about the relevant variables which were or should have been examined. Nevertheless, it has demonstrated that reading by listening to compressed speech is the most efficient medium while reading by braille is the least efficient. These findings offer some implications which will be of interest to both teacher and administrator. In addition, there are some reservations and questions for further research which may serve to qualify the findings.

Is Braille Outmoded?

By no means! This study does not suggest that the baby be thrown out with the bath water. The conclusions are based on but two dimensions of reading behavior, comprehension and time spent on the reading task. Only the reading of prose selections was represented in the measurement of comprehension and time. There are many other factors which need to be considered.

This investigator would agree with those educators

who argue that braille is still the most exact medium for reading. Day and Beech (1966) suggest that the relative superiority of reading print to listening is due to the greater referability or opportunity for quickly reviewing the material that it affords. Reading by listening does not offer the same opportunity for quickly reviewing or retracing the material as does braille.

Braille is also more exact with respect to the acquisition of allied skills such as spelling and punctuation. Extensive dependency on reading by listening, especially at the early elementary grades, would undoubtedly have a detrimental effect on these related skills. Is there a format for reading by listening or are there some other learning procedures which could be employed to offset this disadvantage?

There may be some types of materials which demand the exactness and flexibility of braille. Reading by listening is limited to a temporal dimension, whereas braille provides a spatial dimension. Mathematical problems, maps, charts and graphs are but a few examples of materials which would be better presented in a spatial display.

As Lowenfeld (1945) concluded, reading by listening can only be supplementary to braille. Braille is the only medium available to the blind which also

provides a writing medium. Braille provides a means by which information can be recorded, stored and easily retrieved. For those who experience difficulty in learning to read and write braille, an alternative system for recording and retrieving information could and should be developed.

What Individual Characteristics Differentiate Readers with Respect to an Optimum Medium?

Though most of the high braille readers of this study were also high listeners, a quarter of them were among the low listeners. What are the constellation of variables which distinguish among these groups? Further research is needed to find the answer. This study can only make several observations.

As might be expected, most of the students who were reported as below average in mental ability were to be found in Level IV, the low braille, low listening group. Yet, for Level IV, the highest mean comprehension score was for reading by listening to compressed speech. Would this be true for compressions greater than 250 words per minute?

There were more additional handicaps reported for students within Level IV than for any other level. Is there a particular handicapping condition which would favor one reading medium over another? This study does not provide any conclusive evidence.

With respect to amount of vision, there were many more students with "hand movement" and "reads print with difficulty" reported for the low braille readers, Levels III and IV, than for the high braille readers, Levels I and II. Those who operate in the marginal region between reading print and reading braille do not develop good braille skills. Are there any corrective measures which need to be employed? Is reading by listening an adequate and sufficient alternative for these low vision students?

The students' media preferences (Appendix XIII) and the estimated time spent reading each day for both braille and recordings (Appendix XIV) did not provide any conclusive evidence. In fact, some of the data was inconsistent with the students' reading capabilities. For example, 54 percent of the high braille readers, low listeners preferred recordings for textbooks. Students who were low braille readers, high listeners reported spending twice as much time in braille texts than in recorded texts. Do students prefer the medium for which materials are available? Do educators provide materials in the appropriate medium for students with specific reading capabilities?

It will be noted from Table 8 (page 60) that the low braille readers of Level III took about 10 minutes less than the high braille readers of Level II. Did

the students in Level III do more poorly in braille because they took less time? Or did they take less time because of a frustrating, unrewarding experience with braille?

The reported reading times varied much more for reading by braille than for reading by listening to either normal recording or compressed speech. To an extent, this was expected. However, times for both listening media clustered around the actual recording time much more than anticipated. This would be understandable for Level IV in which 17 students were reported as not knowing how to operate a tape recorder. Why didn't these times vary more for students in the other levels? Do educators teach students how to use the tape recorder as an effective reading device? Does the temporal display of reading by listening mitigate against varying time through skipping or skimming? Would it help to couple the use of compressed speech with the variable speed control available on the American Printing House for the Blind tape recorders? Is there a formal, coding, or indexing system which would facilitate a flexibility in reading by listening?

What Are Some Effective Ways to Utilize Reading by Listening to Compressed Speech?

Comprehension did not differ significantly among

the three media over all subjects. At the same time, reading by listening to compressed speech took much less time than either of the other two media. This implies that reading by listening to compressed speech can more nearly approximate the rate of the silent visual reader without a significant loss in comprehension. It would enable the high school or college student with extensive reading demands to compete more fairly with his sighted colleague. Furthermore, as a result of the current knowledge explosion, greater reading demands are being placed on the adult.

On the negative side, literary enthusiasts have criticized that reading by listening to compressed speech destroys the beauty of the literary work. Robert P. Warren (1970) in an address to the Library of Congress where he received a national literary award, commented that rapid speech represents the "final corruption of language." He also stated that poetry resists rapid speech. What is the effect of reading by listening to compressed speech on one's aesthetic appreciation of the literary work? Does the purpose for reading help dictate an appropriate medium?

Foulke (1970) reported a study to investigate the use of compressed speech for review purposes. Those who reviewed did significantly better than those who did not. Those who reviewed through the use of

normal recordings. The implication is that reading by listening to compressed speech saves time in the reviewing process.

Sticht (1971) summarized his study and others which attempted to use the time saved by using compressed speech to learn additional information through reviewing or reading related material. Neither method resulted in more information learned when compared with a single reading of the uncompressed material. What is the most effective use of the time saved? Is it better to move on to new, unrelated material? Or is it better to rest and recuperate?

Should the Visually Handicapped Reader Have a Greater Choice of Reading Media?

In the preparation and distribution of educational materials for blind children In California between 14 and 21 years of age, comprehension differences among media is not a factor in the choice of an appropriate medium. However, time differences among the three media is a significant factor.

For many years, there was a tremendous struggle to meet the demand for braille texts and recreational books. Through effective legislation, the coordinating efforts of some professional educators and the invaluable contributions of volunteers, an adequate supply of braille books has been provided. For the students who

prefer to read by listening to normal recording, there are increasing amounts of recorded materials available. This study suggests that our schools ought to make available more of these same materials in yet a third medium, compressed speech. The evidence regarding comprehension and time saved is so strong that state departments of education and local school districts would be justified in making every effort possible to make compressed speech materials available to their students.

Not all students have the same reading abilities. Students do not respond to the three reading media in the same way. If the schools continue to place greater emphasis on reading by braille than on reading by listening to either normal recordings or compressed speech, there are some students who will continue to experience frustration and failure in their learning experiences. The evidence of this study is strong enough to suggest that students would do better if they had a choice of the three reading media under study for their texts and recreational books.

Is Reading by Listening an Exclusive Right of the Visually Handicapped?

Recent legislation has recognized the need of other handicapped persons to read by listening. Talking Books and other recorded materials are now available to

those individuals who are prevented from reading print. What about those students who are prevented from reading print but have no apparent handicap? Must they be excluded from the use of recorded materials?

Reading by listening is a valid form of reading. Reading by listening to either normal recordings or compressed speech is an effective and efficient alternative to reading braille. Does it follow that reading by listening to either normal recording or compressed speech may be an effective and efficient alternative to print for some readers?

What is the Significance of This Study?

To summarize, the significance of this study lies in three major areas. First, this study has demonstrated that blind students do not all respond in the same way to reading by braille and reading by listening. There are some students who comprehend significantly more through one medium than the other. This implies that the schools must provide for the specialized needs of these students. Textbooks and recreational materials must be made available in the medium which is most effective for each student.

Secondly, this study has demonstrated that reading by listening to compressed speech is the most efficient of the three reading media under study. This

implies that school districts and state and national agencies must not hesitate to provide materials in compressed speech in order to help meet ever increasing reading demands.

Finally, this study has demonstrated that with respect to average comprehension, reading by listening is an adequate alternative to reading by braille. Furthermore, for information retrieval, reading by listening to compressed speech is more efficient than reading by listening to normal recording which, in turn, is more efficient than reading by braille. An underlying implication is that, since reading by listening is an effective reading media for the blind, it may very well be an effective reading media for the sighted who encounter difficulty reading print.

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Appendix I

Summary of Proposed Study

"A Comparison of Three Reading Media Available to the Blind: Braille, Normal Recordings and Compressed Speech"

I. Statement of the Problem:

The average silent visual reader reads at a rate of 250 to 300 words per minute. Three of the alternatives to print reading available to the blind are braille, normal recordings and compressed speech. Each has its own advantages and disadvantages:

Braille: Generally accepted alternative to print...best tactual system...yet bulky and slow (104 words per minute average)
Normal Recordings: Reading by listening is another alternative (175 wpm)...lose advantages of spacial display
Compressed Speech: A third alternative becoming available...speeds up recordings without voice or pitch distortion (275 wpm)

On the other hand, multiply handicapped blind children who encounter difficulty with braille, may very well learn more efficiently with normal recordings. On the other hand, college bound blind students who encounter ever increasing reading demands may find compressed speech more efficient. The point is that educators do not currently have the answer.

II. Question to be Answered:

For blind students age 14 to 21 with given braille

and listening skills, which of the three reading alternatives, braille, normal recordings, or compressed speech, is most efficient?

III. Procedure:

A minimum of 100 blind students age 14 to 21 will be divided into four groups: 1. high braille, high listening skills; 2. high braille, low listening skills; 3. low braille, high listening skills; and 4. low braille, low listening skills. Each student will be asked to take three equivalent forms of the Reading Versatility Test, Intermediate Level, (EDL), each in a different mode: braille, normal recording, and compressed speech. Prior to taking the compressed speech version, each student will be exposed to five half-hour compressed speech reading selections in an effort to orient him to this relatively new reading mode.

IV. Results:

The results will be analyzed with reference to an index of learning efficiency which is the number of correct responses per unit of time spent on the reading task. These results will be made available to participating districts.

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Appendix II

Initial Letter to School District Administrators

Dr. John Doe
Superintendent of Schools or
Director of Special Education
Hometown, California

Dear Dr. Doe:

After speaking with Miss Dorothy Misbach and Miss Joan Sweeney, Consultants for the Visually Handicapped, State Department of Education, about my concerns they encouraged me to contact you.

I am seeking help from you in securing your district's permission

1. to include your blind students age 14 to 21 in a reading study and

2. to contact and work through your resource or itinerant teacher(s) of the visually handicapped.

My interest and concern in the reading problems of the blind grew out of my experience as Principal of the California School for the Blind, Berkeley, and as a resource-itinerant teacher of the visually handicapped in a local public school program in California. In addition to the cooperation and support of the State Department of Education, I am privileged to have the guidance of two outstanding, nationally recognized specialists: Miss Georgie Lee Abel, Professor of Special Education, San Francisco State College; and Dr. Eli Bower, Professor of Education, University of California at Berkeley.

For your information, a brief summary of the study is attached. In short, this study will demand of each pupil four hours spread out over two weeks. I would like to initiate the study in your district in March.

Appendix II (continued)

I would be pleased if I could count on your district's cooperation and support. For your convenience there is a self-addressed card enclosed for your response. If you have further questions, don't hesitate to contact me at 4-51/527-4356.

Sincerely,

Dean W. Tuttle

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Appendix III

First Letter to the Teacher of the Visually Handicapped

333 Pomona Avenue
El Cerrito, California 94530

February 25, 1971

Mr. John Doe, Resource Teacher
Hometown High School
Hometown, California

Dear John:

Your district administrators have granted me permission to seek your cooperation in a study of three reading media available to visually handicapped students. Enclosed is a summary of the study which I sent to your administrators.

For design purposes, I need to include 100 braille readers, age 14 through 21 years of age. As you know, this means I will need to include almost every braille student of that age in California. Because of the geographic distances, it will be impossible for me to meet with each student. Consequently, I will be relying on you to distribute and administer various aspects of the study.

Each student will be asked to listen to five 20 minute compressed reading selections to orient him to this mode of reading. Then he will be asked to take three equivalent forms of the Reading Versatility Test: one in braille, one in normal recording and one in compressed speech. Each test contains four short reading selections each focusing on a different task: reading for general information, reading for a detailed information, skimming for main ideas and scanning for a specific idea. Each test contains

24 multiple-choice questions.

In summary, this study will require:

1. of you or a volunteer you designate help in distributing materials and administering reading tests. (As budget permits, a small honorarium will be given to you for your participation in the project.)

2. of each student, listening to five compressed reading selections and taking three reading tests in braille, normal recordings and compressed speech. (A complete book in compressed speech will be given to each student who participates in the project.)

3. Will require of parents, permission to include their child in this study. (Forms for this purpose will be sent at a later date.)

May I count on your cooperation in this reading study? If so, how many students do you have who are braille users 14 through 21 years of age?

Cordially,

Dean W. Tuttle

Enc: response card

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Appendix IV

Second Letter to Teacher of the Visually Handicapped and Parent Permission Form

333 Pomona Avenue
El Cerrito, California 94530

March, 1971

Mr. John Doe
Teacher of the Visually Handicapped
Hometown High School
Hometown, California

Dear John,

You undoubtedly are wondering what specifically is expected of you or the volunteer you designate in this reading study. There are three steps, the last being most important.

1. Parent Permission: It is important that we secure the permission of each parent or guardian. Enclosed you will find a form letter for each of your students. Would you please fill in the name of the parent or guardian at the top and the name of the child, and secure the appropriate signatures by whatever means. In some cases, we may have to resort to a verbal consent granted over the phone. Please return to me either the signed form or a note indicating verbal consent granted by phone.

2. Treatment Phase in Compressed Speech Reading: To orient all students to compressed speech, each student will be asked to listen to five 20-minute compressed reading selections: two at 25% compression, two at 35% compression and one combination of 30%, 40% and 50% compression.

In an effort to keep the students honest, there are three multiple-choice questions for each reading selection. Ask the students to record their answers

either in braille, on the typewriter or by dictation. Please return these responses to me.

These materials are still in the process of being prepared. They will be sent to you as soon as they are finished. The students can listen to them at their own convenience and leisure either at home or school wherever they have access to a tape recorder (two track, 3 3/4 ips). Each student should have completed this step before he commences with the next.

3. Administration of Reading Versatility Test: Each student will be asked to take three equivalent forms of the Reading Versatility Test: one in braille, one in normal recording and one in compressed speech. The student should be encouraged to use his normal reading habits. He may retrace any or all of the reading selection as he feels the need. He may not return to the selection after beginning the questions. Though there is no time limit, an accurate record of the time spent on each reading selection (not to include time spent on the questions) must be kept for each student. (Exception: time should be called after 15 minutes spent on each reading selection for the very slow braille readers.)

There are four short reading selections in each test. Part I is reading for general information and is followed by 10 questions. Part II is reading for detailed information and is also followed by 10 questions. Part III is skimming for main ideas followed by three questions. Part IV is scanning for a specific idea with only one question to be answered. All 24 questions in each test are of the multiple-choice type. It is suggested that the student mark his answers with a pencil or crayon on the answer sheet provided with the test materials. If your student is unable to do this, answering by dictation is permissable.

The Reading Versatility test has four equivalent forms: A, B, C, and D. Each form has been reproduced in all three media, braille, normal recording and compressed speech. Each student will be assigned which form to take, in which media, and in what order. (These specifics will be sent later with the test materials.)

I would like to express again my indebtedness to you for being willing to cooperate in this state-wide, state supported project. I have been gratified for

the positive responses from so many districts throughout the state. Each additional student provides us with a little better information. I particularly want to include students at the top and bottom end of the braille continuum. I would like to extend my thanks through you to each of these students.

Sincerely,

Dean W. Tuttle

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Appendix (continued)

Educational Psychology Division
Room 4511

March, 1971

Dear Parent:

I am seeking your permission to include your child in a reading study. Let me briefly explain what would be involved.

As you know, reading is one of the most important skills learned in school. There are three alternatives to print available to the visually handicapped: braille, normal recordings such as Talking Book, and compressed speech.

> Braille: Best tactual system, yet bulky and slow, 104 words per minute average.
>
> Normal recordings: Reading by listening is another alternative, 175 words per minute.
>
> Compressed speech: Speeds up recordings without voice or pitch distortion, 275 words per minute.

Each of these reading media have advantages and disadvantages and students vary in their ability to use them. This study is attempting to determine which student finds which reading media most efficient.

First, your child will be asked to listen to five twenty-minute compressed recreational reading selections, to become oriented to this new mode of reading. Then he will be asked to take three short reading tests; one in braille, one in normal recording, and one in compressed speech. All together, the study will demand about four hours of your child's time spread out over two or three weeks. You as a parent will not be asked to participate in the study.

Appendix IV (continued)

I would appreciate your completing the form below and returning it to the teacher who will be helping with the study. If you have any questions, feel free to discuss them with the teacher or with me.

Sincerely,

Dean W. Tuttle

As parent (or guardian), I grant my permission for

______________________________ to be included in the

reading study described.

Date________________________ Signed____________________

Address____________________

P.S. For participating in the study, I want to give each child a complete book in compressed speech. It would help me to know:

Do you or your child own a tape recorder? Yes No
two-track_____ or four track_____,
1 7/8, 3 3/4 or 7½ speeds

Appendix V

Phase II - Instructions

Phase 2 of Reading Study: Reading by Listening to Compressed Speech

Instructions

Reading by listening to compressed speech can be fun and enjoyable. Though there is no distortion in pitch or voice quality, the reading material is covered at a much faster rate.

What are the materials?

There are five 20-minute reading selections with three multiple-choice questions for each selection. For both tapes 1 and 2, the reading selection on track one has been compressed by 25% (225 words per minute) while the selection on track two has been compressed by 35% (265 wpm). Tape 3 contains a combination of 30%, 40%, and 50% compressions (245 wpm, 285 wpm, and 340 wpm). The rate to be used later in Phase 3 on the compressed speech reading test will be 250 words per minute.

Who should listen?

Every student who will be participating in the study.

For what purpose?

So everyone in the study will have a common orientation to this mode of reading.

When?

These five compressed reading selections can be read at the students' convenience either during or after school time.

Where?

Either at school or at home.

Equipment needed?

The student needs to have access to a tape recorder (two track, 3 3/4 ips). For better intelligibility and comprehension, use earphones if possible.

In what order?

The order of reading tapes 1 and 2 is irrelevant.

Appendix VV (continued)

Tape 3 should be saved till last.

Answers to the questions?

Following each reading selection there are 3 multiple-choice questions to be answered. They can be answered in either braille, print, or typing. Be sure student's name is on his sheet of answers.

Please return the tapes and students' answer sheet to:

Dean W. Tuttle
333 Pomona Avenue
El Cerrito, California 94530

Multiple Choice Questions

Instructions: Write your answers to the following questions on another piece of paper. Each question will be read twice. If you do not know the answer, make an intelligent guess.

Tape 1, Side 1: From the Earth to the Moon

1. The crowd which had gathered to hear Ardon was described as

   a. patient
   b. unenthusiastic
   c. antagonistic
   d. unruly

2. Ardon was

   a. proud
   b. bitter
   c. self-assured
   d. embarassed

3. Ardon was convinced that

   a. there is no life on the moon
   b. there may be life on the moon
   c. there is life on the moon.
   d. life can be sustained only on the earth

Tape 1, Side 2: Sandy Koufax

1. In the game of baseball, the pitcher's mound

   a. is primarily a safety precaution
   b. is not really necessary
   c. gives the batter a decided advantage
   d. gives the pitcher a decided advantage

2. In the early 1900's, a baseball player who could boast of 8 homeruns in one season was unusual. More recently, the increase in number of homeruns is accompanied by

- a. an increase in the number of walks
- b. an increase in the number of hits
- c. an increase in the number of stolen bases
- d. an increase in the number of strike-outs

3. One of the records set by Sandy Koufax was

    - a. 18 strike-outs in a single game against the Giants
    - b. 7 successive no-hitters
    - c. the lowest earned-run average of 1.56 for a single season
    - d. 6 hit batters in a single game against the Braves

Tape 2, Side 1: Land of the Free

1. Early Americans of the 18th Century

    - a. were inventors
    - b. borrowed ideas
    - c. made due with what they had
    - d. had little need for change

2. Whitney's cotton gin

    - a. made him rich
    - b. could not be copied
    - c. made him famous
    - d. was not appreciated at first

3. Interchangeable parts, which became known as the American System, was first used with

    - a. the railroad
    - b. the threshing machine
    - c. the steam engine
    - d. the muscat

Tape 2, Side 2: The Case of the Beautiful Beggar

1. Daphney could be described as

    - a. impatient, saucy and proud
    - b. a wealthy and beautiful widower
    - c. selfish and unconcerned

d. 22, naive and demure

2. Uncle Horace sent Daphney a check for:

   a. $125
   b. $25,000
   c. $125,000
   d. $500,000

3. Aunt Eleanor was

   a. an impostor
   b. a trained nurse
   c. patient and kind
   d. Uncle Horace's niece

Tape 3: "Two Chests of Treasure"

Following the first break:

1. The key to survival for Roger and the pirate captain was

   a. in Roger's small sail boat
   b. the food and shelter available from the islanders
   c. the return of the ship
   d. in Mother Nature

Following the second break:

2. The two chests which the Captain buried on the island were filled with

   a. gold
   b. jewels
   c. sand
   d. secret papers

Following the third break:

3. Roger was rescued by

   a. the pirate crew
   b. his father
   c. the pirate captain
   d. no one

Appendix VI

Practice Sheet

(The Practice Sheet appeared in braille only)

For the braille test, read the entire question and then draw a line under the letter of your choice. Use the following two sample questions for practice.

1. The man who works on teeth is known as a
   - a. lawyer
   - b. dentist
   - c. merchant
   - d. plumber
2. The national sport of the United States is considered to be
   - a. football
   - b. basketball
   - c. baseball
   - d. boxing

For the recorded tests, listen to the question and then place a mark in the box next to the letter of your choice.

1. a ☐ b ☐ c ☐ d ☐

2. a ☐ b ☐ c ☐ d ☐

Appendix VII

Sample of Answer Sheet for Recorded Tests

(The answer sheet appeared in braille only)

Reading Versatility Test

Normal Recording Form A

Part 1

1.	a	☐	b	☐	c	☐	d	☐
2.	a	☐	b	☐	c	☐	d	☐
3.	a	☐	b	☐	c	☐	d	☐
4.	a	☐	b	☐	c	☐	d	☐
5.	a	☐	b	☐	c	☐	d	☐
6.	a	☐	b	☐	c	☐	d	☐
7.	a	☐	b	☐	c	☐	d	☐
8.	a	☐	b	☐	c	☐	d	☐
9.	a	☐	b	☐	c	☐	d	☐
10.	a	☐	b	☐	c	☐	d	☐

Appendix VIII

Student Data Sheet

The following information will be held in strict confidence. All results will be reported anonymously.

Name of Student:______________________Birthdate:_______Grade______

Testing Procedure

Order	Media	Form	Reading Time (to the nearest 10 sec. interval) Part 1	Part 2	Part 3	Part 4
First	______	_____	_______	_______	_______	_______
Second	______	_____	_______	_______	_______	_______
Third	______	_____	_______	_______	_______	_______

Examiners' comments regarding unusual circumstances (interruptions, illness, etc.)__________________________

____

The following information is needed to help interpret results of the study:

Recorded IQ score is ______ as measured by _______________

Test.

If IQ score is unavailable, would you estimate this student's mental ability

as below average ______ average ______ above

average ______?

Amount of student's vision:

Totally Blind ______ Light Perception ______

Hand Movements ______ Good travel vision ______

Can read print with difficulty ______

Appendix VIII (continued)

How long has the student been blind?

Less than 1 year _____ 1-2 _____ 3-5 _____

6-10 _____ more than 10 _____

The student started receiving braille reading instruction in

K-1 _____ 2-3 _____ 4-6 _____ 7-9 _____

10-12 _____

Check additional handicaps the student has (if any)

Hearing _____ Speech _____ Orthopedic _____

Emotional _____ Neurological _____ Other _____

Student knows how to operate a tape recorder?

Yes _____ No _____

Student comes from bilingual home where another language is used extensively?

Yes _____ No _____

To be filled out by Student

Name of Student ____________________________

Please answer the following questions as accurately as you can.

What is the average time spent each day reading?

Braille texts _____ Braille recreational material _____

Recorded texts _____ Recorded recreational material _____

Which mode do you prefer

for school texts? Braille _____ Recordings _____

for recreation? Braille _____ Recordings _____

Appendix VIII (continued)

After the completion of the study, I want to give to you a complete book in compressed speech. Please indicate your first and second choices of the following available titles:

(Compressed 25%)

___ Old Yeller, by F. B. Gipson

___ Hottest Fourth of July in the History of Hangtree County, by C. Adams

___ Miracles on Maple Hill by V. Sorensen

___ Silver Chief by C. O'Brien

(Compressed 35%)

___ Watch for a Tall White Sail, by M. E. Bell

___ Island of the Blue Dolphins, by Scott O'Dell

___ Sandy Koufax, by A. Hano

___ Case of the Beautiful Beggar, by E. S. Gardner

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Appendix IX

Phase III - Instructions for Test Administration

333 Pomona Avenue
El Cerrito, California 94530

April 16, 1971

Greetings:

This is it...the last and most important.

You will be receiving no further instructions.

Uniformity of test administration is important. Please read the directions on the next two pages carefully before attempting to administer any tests.

If you have any questions, please don't hesitate to call me collect at area code 415, phone 527-4356. Thank you again for your cooperation and your willingness to participate in the project.

Cordially,

Dean W. Tuttle

Appendix IX

(continued)

Phase III of Reading Study

Instructions for Administering Reading Versatility Test: Forms A, B, C, and D

Each student will be asked to take three different forms of the Reading Versatility Test, one in braille, one in normal recording and one in compressed speech. The three tests and appropriate answer sheets are packed along with a data sheet for each student. The data sheet will indicate the order in which the tests are to be administered and which form has been assigned to each of the three media.

Time Requirements:

Allow about 40-50 minutes for the recorded version and 70-80 minutes for the braille version. (Because there is no time limit some students may take excessively long reading the selection. Feel free to call time after 15 minutes and have him begin the questions.)

Materials Needed:

Timer (stop watch, clock or watch with second hand)
Pencil, (soft lead) for each student
Practice answer sheet (provided). (There are two practice questions in braille and two practice questions of the recorded type.)
For the braille version:
    Braille test booklet (students are to mark answers in test booklet)
For the recorded versions:
    Tape of the test booklet (3 3/4 ips)
    Tape recorder for the student's use. (Since the students are permitted to retrace or reread any of the reading selections before they begin answering the questions, each student must be free to operate his own machine.)
    Earphones: Advisable if tests are being group-administered.

Practice Marking the Answers:

Give each student his practice sheet. Say to the student(s):

"Before beginning the reading test, I want to be sure you know how to mark your answers.

"If you are taking the braille version of the test, you will be marking your answers in the test booklet itself. First read the question and the four possible answers a, b, c, and d. After choosing the correct answer, place the index finger of one hand on the letter of your choice. With the other hand, take a pencil and draw a line under that letter. Now see if you can answer the two questions at the top of the practice sheet.

"If you are taking a recorded version of the test, each question will be read twice. The answer sheet provides a box or rectangle to the right of each letter a, b, c, and d. After choosing the correct answer, place a mark in the box beside the letter of your choice. Now see if you can answer the following two questions at the bottom of your practice sheet.

"Number 1. The governor of our state is elected

a. every four years
b. every three years
c. every two years
d. every year."

(Please reread the question a second time)

"Number 2. The capitol of California is located in

a. San Diego
b. Los Angeles
c. Sacramento
d. San Francisco."

(Please reread the question a second time. Check to make sure students have marked the answer sheets clearly.)

Administering the Test:

(After distributing the appropriate materials, say to the student(s):

"There are four parts to this test. Each part has its own directions. You will need to read these directions for each part either on tape or in braille,

stop and wait for the starting signal to begin the reading selection. You may reread or retrace any of the reading selection as long as you do so before you start answering the questions. Be sure to indicate when you have finished each reading selection so that I may record your time spent reading each of the four selections. When you have finished answering the questions, read the directions for the next part and again wait for the starting signal."

(On the recorded tests, a beep which marks the beginning of the questions can be heard on fast forward when using an APH modified tape recorder.)

"Now read the directions for Part 1 and wait for the signal to begin the reading selection." (Pause and wait for students to finish reading the directions.)

"You may now begin the reading selection for Part 1. Don't forget to let me know when you have finished." (Record beginning and ending time for each part in hours, minutes and seconds.)

Student Data Sheet:

Please fill out the first page of the student data sheet as best you can. Then help the student complete the second page. All information will be kept in strict confidence and all results will be reported anonymously.

Returning the Test Materials:

Check to see that the students' names are on the answer sheets and test booklets. When all of the students have finished taking all three tests, please return the test booklets, answer sheets, tapes and student data sheet to me.

Dean W. Tuttle
333 Pomona Avenue
El Cerrito, California 94530

Appendix X

Distribution of the Effects of Form and Order for Administration of the Reading Versatility Test - Intermediate Level

Treatment Number	First Administration	Second Administration	Third Administration	Identification Number
*1.	Br - A	NR - B	CS - C	9-1
2.	Br - A	CS - B	NR - C	27-1
*3.	NR - C	CS - D	Br - B	40-1
*4.	CS - C	NR - D	Br - B	7-1
*5.	CS - A	Br - C	NR - D	11-1
*6.	NR - A	Br - C	CS - D	23-1
*7.	Br - D	NR - A	CS - B	9-2
8.	Br - D	CS - A	NR - B	27-2
*9.	NR - B	CS - C	Br - A	40-2
*10.	CS - B	NR - C	Br - A	7-2
*11	CS - D	Br - B	NR - C	14-1
*12.	NR - D	Br - B	CS - C	1-1
*13.	Br - C	NR - D	CS - A	9-3
14.	Br - C	CS - D	NR - A	27-3
*15.	NR - A	CS - B	Br - D	40-3
*16.	CS - A	NR - B	Br - D	7-3
*17.	CS - C	Br - A	NR - B	19-1
*18.	NR - C	Br - A	CS - B	1-2
*19.	Br - B	NR - C	CS - D	9-4
20.	Br - B	CS - C	NR - D	27-4

*Completed test satisfactorily

Appendix X (continued)

Treatment Number	First Administration	Second Administration	Third Administration	Identification Number
*21.	NR - D	CS - A	Br - C	40-4
*22.	CS - D	NR - A	Br - C	7-4
*23.	CS - B	Br - D	NR - A	39-1
*24.	NR - B	Br - D	CS - A	1-3
*25.	Br - A	NR - B	CS - C	9-5
26.	Br - A	CS - B	NR - C	27-5
*27.	NR - C	CS - D	Br - B	40-5
*28.	CS - C	NR - D	Br - B	7-5
29.	CS - A	Br - C	NR - D	45-1
*30.	NR - A	Br - C	CS - D	1-4
31.	Br - D	NR - A	CS - B	9-6
32.	Br - D	CS - A	NR - B	27-6
*33.	NR - B	CS - C	Br - A	40-6
*34.	CS - B	NR - C	Br - A	7-6
*35.	CS - D	Br - B	NR - C	43-1
36.	NR - D	Br - B	CS - C	1-5
*37.	Br - C	NR - D	CS - A	9-7
38.	Br - C	CS - D	NR - A	27-7
*39	NR - A	CS - B	Br - D	40-7
40.	CS - A	NR - B	Br - D	7-7
*41.	CS - C	Br - A	NR - B	43-2
*42.	NR - C	Br - A	CS - B	10-1
*43.	Br - B	NR - C	CS - D	9-8

Appendix X (continued)

Treatment Number	First Administration	Second Administration	Third Administration	Identification Number
44.	Br - B	CS - C	NR - D	27-8
*45.	NR - D	CS - A	Br - C	40-8
*46.	CS - D	NR - A	Br - C	7-8
47.	CS - B	Br - D	NR - A	5-1
*48.	NR- B	Br - D	CS - A	10-2
*49.	Br - A	NR - B	CS - C	9-9
*50	Br - A	CS - B	NR - C	12-1
*51.	NR - C	CS - D	Br - B	40-9
*52.	CS - C	NR - D	Br - B	7-9
53.	CS - A	Br - C	NR - D	5-2
*54.	NR - A	Br - C	CS - D	10-3
*55.	Br - D	NR - A	CS - B	9-10
*56.	Br - D	CS - A	NR - B	12-2
57.	NR - B	CS - C	Br - A	46-1
*58.	CS - B	NR - C	Br - A	7-10
*59.	CS - D	Br - B	NR - C	15-1
*60.	NR - D	Br - B	CS - C	10-4
*61.	Br - C	NR - D	CS - A	9-11
*62.	Br - C	CS - D	NR - A	12-3
*63.	NR - A	CS - B	Br - D	46-2
*64.	CS - A	NR - B	Br - D	7-11
*65.	CS - C	Br - A	NR - B	15-2
66.	NR - C	Br - A	CS - B	21-1
*67.	Br - B	NR - C	CS - D	17-1

Appendix X (continued)

Treatment Number	First Administration	Second Administration	Third Administration	Identification Number
*68.	Br - B	CS - C	NR - D	12-4
*69.	NR - D	CS - A	Br - C	46-3
*70.	CS - D	NR - A	Br - C	7-12
*71.	CS - B	Br - D	NR - A	15-3
*72.	NR - B	Br - D	CS - A	21-2
*73.	Br - A	NR - B	CS - C	24-1
74.	Br - A	CS - B	NR - C	29-1
*75.	NR - C	CS - D	Br - B	46-4
*76.	CS - C	NR - D	Br - B	36-1
*77.	CS - A	Br - C	NB - D	11-2
*78.	NR - A	Br - C	CS - D	23-2
*79.	Br - D	NR - A	CS - B	24-2
80.	Br - D	CS - A	NR - B	29-2
*81.	NR - B	CS - C	Br - A	46-5
*82.	CS - B	NR - C	Br - A	36-2
83.	Cs - D	Br - B	NR - C	14-2
*84.	NR - D	Br - B	CS - C	21-3
*85.	Br - C	NR - D	CS - A	24-3
86.	Br - C	CS - D	NR - A	29-3
*87.	NR - A	CS - B	Br - D	46-6
*88.	CS - A	NR - B	Br - D	36-3
*89.	CS - C	Br - A	NR - B	19-2
90.	NR - C	Br - A	CS - B	22-1
91.	Br - B	NR - C	CS - D	24-4

Appendix X (continued)

Treatment Number	First Administration	Second Administration	Third Administration	Identification Number
92.	Br - B	CS - C	NR - D	29-4
*93.	NR - D	CS - A	Br - C	46-7
*94.	CS - C	NR - A	Br - C	36-4
*95.	CS - B	Br - D	NR - A	39-2
96.	NR - B	Br - D	CS - A	22-2
97.	Br - A	NR - B	CS - C	24-5
98.	Br - A	CS - B	NR - C	29-5
*99.	NR - C	CS - D	Br - B	46-8
*100.	CS - C	NR - D	Br - B	36-5
101.	CS - A	Br - C	NR - D	45-2
102.	NR - A	Br - C	CS - D	22-3
*103.	Br - D	NR - A	CS - B	24-6
104.	Br - D	CS - A	NR - B	19-3
*105.	NR - B	CS - C	Br - A	46-9
*106.	CS - B	NR - C	Br - A	25-1
*107.	CS - D	Br - B	NR - C	15-4
108.	NR - D	Br - B	CS - C	22-4
109.	Br - C	NR - D	CS - A	24-7
*110.	Br - C	CS - D	NR - A	23-4
*111.	NR - A	CS - B	Br - D	46-10
*112.	CS - A	NR - B	Br - D	25-2
113.	CS - C	Br - A	NR - B	26-1
*114.	NR - C	Br - A	CS - B	30-1
*115.	Br - B	NR - C	CS - D	24-8

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Appendix X (continued)

Treatment Number	First Administration	Second Administration	Third Administration	Identification Number
*116.	Br - B	CS - C	NR - D	23-5
*117.	NR - D	CS - A	Br - C	46-11
*118.	CS - D	NR - A	Br - C	25-3
*119.	CS - B	Br - D	NR - A	31-1
*120.	NR - B	Br - D	CS - A	30-2
*121.	Br - A	NR - B	CS - C	38-1
*122.	Br - A	CS - B	NR - C	23-6
*123.	NR - C	CS - D	Br - B	46-12
*124.	CS - C	NR - D	Br - B	41-1
*125.	CS - A	Br - C	NR - D	31-2
126.	NR - A	Br - C	CS - D	30-3
*127.	Br - D	NR - A	CS - B	38-2
128.	Br - D	CS - A	NR - B	44-1
*129.	NR - B	CS - C	Br - A	46-13
*130.	CS - B	NR - C	Br - A	41-2
*131.	CS - D	Br - B	NR - C	31-3
132.	NR - D	Br - B	CS - C	15-5
133.	Br - C	NR - D	CS - A	38-3
134.	Br - C	CS - D	NR - A	44-2
135.	NR - A	CS - B	Br - D	46-14
*136.	CS - A	NR - B	Br - D	41-3
*137.	CS - C	Br - A	NR - B	31-4
138.	NR - C	Br - A	CS - B	15-6
139.	Br - B	NR - C	CS - D	

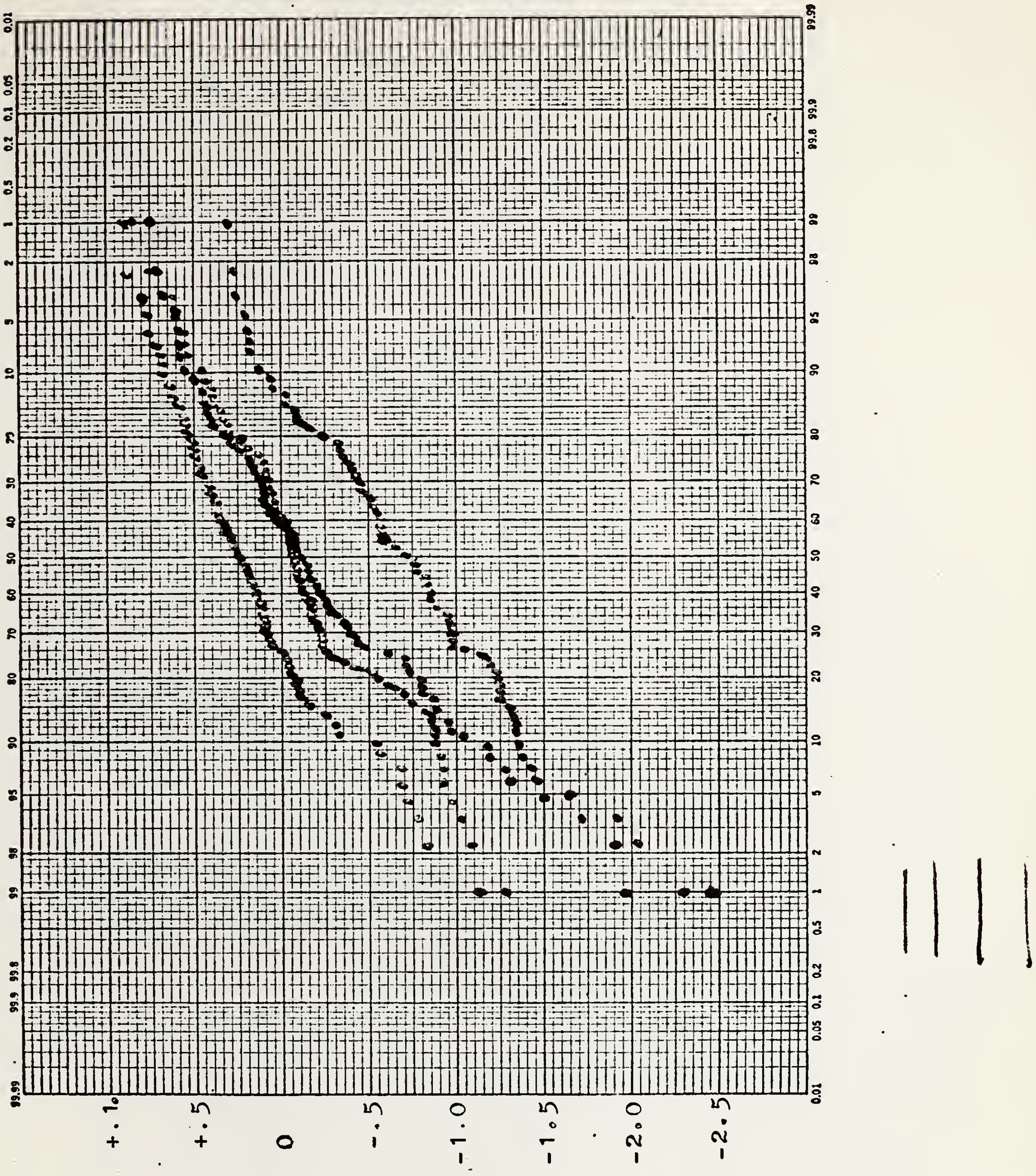
Appendix X (continued)

Treatment Number	First Administration	Second Administration	Third Administration	Identification Number
140.	Br - B	CS - C	NR - D	44-3
*141.	NR - D	CS - A	Br - C	46-15
*142.	CS - D	NR - A	Br - C	41-4
143.	CS - B	Br - D	NR - A	5-3
144.	NR - B	Br - D	CS - A	5-5
145.	Br - A	NR - B	CS - C	
146.	Br - A	CS - B	NR - C	
*147.	NR - C	CS - D	Br - B	46-16
*148.	CS - C	NR - D	Br - B	7-13
149.	CS - A	Br - C	NR - D	5-4
150.	NR - A	Br - C	CS - D	5-6
*151.	NR - B	CS - C	Br - A	46-17
152.	NR - D	Br - B	CS - C	5-7
153.	NB - C	Br - A	CS - B	5-8

Appendix XI

The Normal Distribution of the Log of the Index of Learning Efficiency for All Tests within Each Level

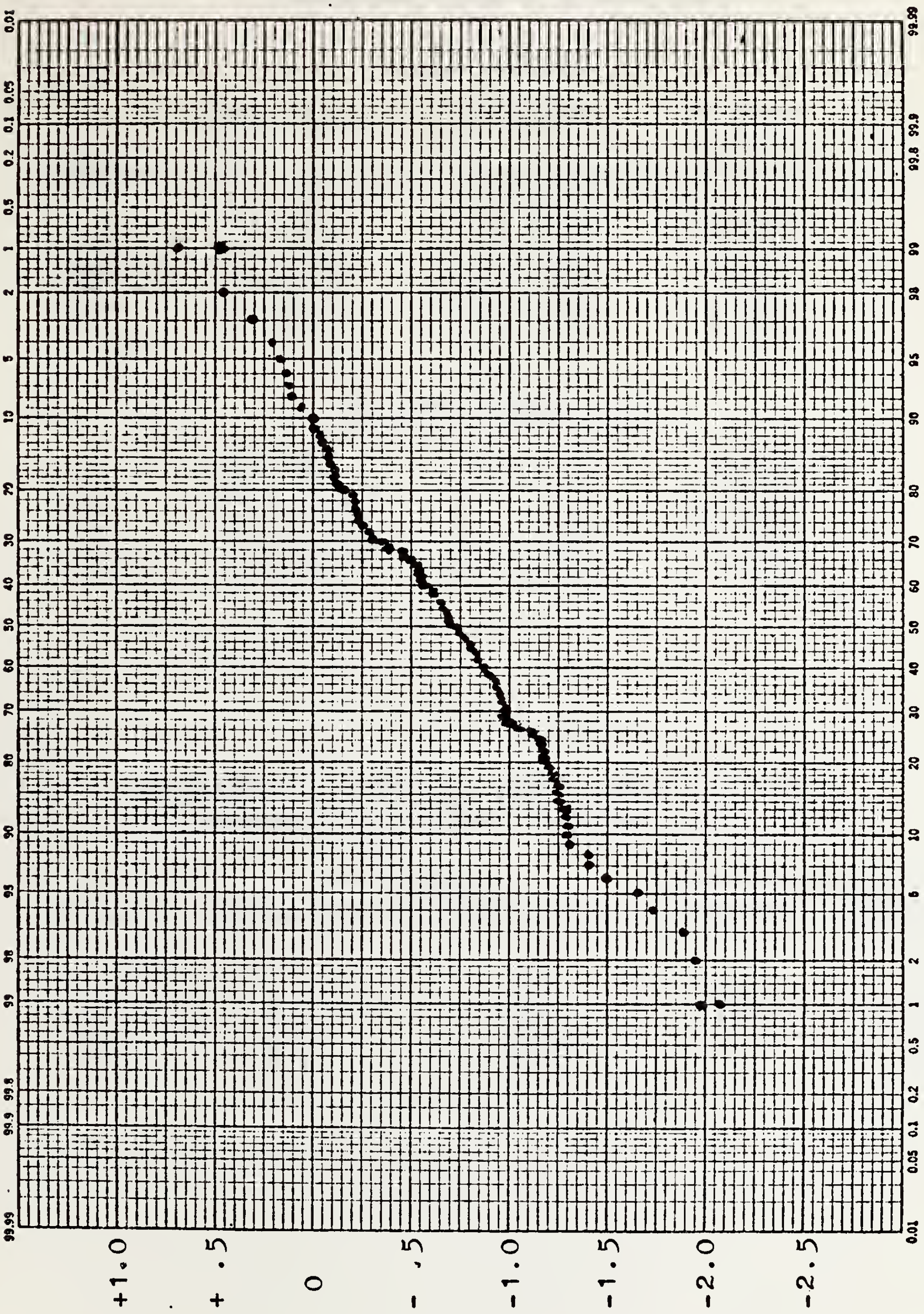
Figure 5 Arithmetic normal paper.



Appendix XII

The Normal Distribution of the Log of the Index of Learning Efficiency for all Braille Tests

Figure 5 Arithmetic normal paper.



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Appendix XIII

Students' Media Preferences

Textbooks

Level	Braille %	n	Recorded %	n	Either %	n
I	56	(22)	33	(13)	10	(4)
II	38	(5)	54	(7)	8	(1)
III	31	(4)	69	(9)	0	(0)
IV	54	(21)	41	(16)	5	(2)
Overall	50	(52)	44	(45)	7	(7)
Recreational Books						
I	38	(15)	59	(23)	3	(1)
II	38	(5)	46	(6)	15	(2)
III	23	(3)	62	(8)	15	(2)
IV	33	(13)	59	(23)	8	(3)
Overall	35	(36)	58	(60)	8	(8)

Appendix XIV

Students' Estimates of Time (in Quarter Hours) Spent Reading Each Day

	Textbooks		Recreational Books	
Level	Braille	Recorded	Braille	Recorded
I	4.2	2.7	2.7	2.9
II	3.5	3.2	4.5	3.3
III	3.9	1.5	2.2	2.8
IV	2.6	2.0	2.6	2.1

Appendix XV

Teachers Participating in the Testing Procedure

This investigator is indebted to the following teachers who took time from their busy schedules to help distribute materials and administer tests:

Mrs. Jean Alexander, San Jose

Miss G. Buzard, La Mirada

Mr. Myron Carrothers, Fresno

Mr. John Cody, Walnut Creek

Mr. Bud Corkery, Modesto

Mrs. Jean Croft, Fresno County

Miss Marcia deZwarte, San Rafael

Mr. Leroy Dinges, San Francisco

Mr. Matthew M. Faust, Santa Rosa

Mrs. Muriel Howard, Butte County

Miss Vera Hurst, Oakland

Mr. Ed Jacobs, San Junified

Mrs. L. Jenkins, Berkeley

Mrs. Ann King, Berkeley

Mr. Keith Lindersmith, Visalia

Mr. Gale Lutz, San Diego

Mr. Bob McMullen, Oakland

Mrs. Marge Miller, Novato

Mr. Ken Mogren, Sacramento

Mr. Robert Montgomery, Redding

Mrs. Peggy Robertson, Azusa

Mrs. Barbara Rubin, Fresno

Appendix XV (continued)

Miss Nancy Rubin, Berkeley

Mr. Don Steward, Sunnyvale

Mrs. M. Pauline Taylor, Stockton

Mr. Don Teague, Monterey

Mrs. Hazel Turner, Ventura

Mr. W. E. Wallace, Sacramento

Miss Sybil Westbrook, San Juan Unified

Mr. Herbert Youngdahl, San Francisco

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